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ANTHROPOMETRIC EFFECTS OF RECORDED CASES OF MISCEGENATION AMONG CERTAIN CAUCASIAN SUB-GROUPS

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The "Galilee Skull" discovered by Tiberias on the Sea of Galilee may link primitive man of the region of Asia Minor to Abraham, Isaac, and Jacob, who successively wandered over the Plains of Mesopotamia. With them begin the extensive migrations of the Jewish people.

The households of Abraham, Isaac, and Jacob constitute the initial stock of the Israelites. Famine drove them into Egypt, where they were permitted to settle in the province of Goshen. By 1600 B. C. the position of the Israelites deteriorated in Egypt. "Their religion may have been corrupt, but it stood out in favorable contrast to the fantastic polytheism of their masters." (Roth 1936). As a result of this Moses led the tribe from Egypt via the Red Sea to Palestine. This happened between 1400 and 1200 B. C. The following 1500 years of sojourn in Asia Minor produced among the Jewish people another Oriental Scripture, the Old Testament.

Continuing from Palestine certain groups of Jews migrated to Armenia and the Caucausus. Ripley (1899) reported records of their presence in this region one or two centuries before Christ. Their first appearance in south east Russia was in the eighth century after Christ. The Jews reached Ruthenia from the tenth to the eleventh century and arrived in Poland from the twelfth to the fourteenth century. A small secondary centre of Jewish aggregation appeared about Frankfort, this group having come via the Mediterranean, and the Rhone-Rhine Route (Fig. 1).

Germany became divided politically and Russia interdicted them after 1110 A. D. Owing to the fearful persecutions all over Europe attendant upon the Crusades the Jews continued migrant. The Polish kings desiring to encourage the growth of their city population offered the rights of citizenship to all who would come to Poland. From Frankfort an exodus in mass took place toward the end of the sixteenth century. Alarm then caused restrictive legislations in eastern Europe, and since the sixteenth century the Jews have concentrated in Poland and in the eastern and southern European states for several hundred years, (Ripley 1899).

From Spain many Jews went to North Africa, particularly to Morocco and Tripoli. Others migrated to the Balkans. Cecil Roth (1936) reports that in 1492 an edict was issued that all Jews should be driven from Spain. The same year the discovery of the New World opened another possibility of migration, namely toward America. However, Jewish immigration to America gained momentum only toward the end of the nineteenth century (Fig. 1).

Geographical distribution of the Jewish people of Europe and America during the nineteenth and twentieth centuries can be summarized briefly. Toward the end of the nineteenth century there were between eight and nine million Jews in the world. Of these six or seven million were in Europe, the remainder being sparsely scattered over the whole world. Fully one half of all these Jews resided in Russia, namely four to five million. Austria Hungary had two million. Germany and Roumania had six to seven hundred thousand each. The British Isles had only about one hundred thousand, and these were mostly in London. Scotland and Ireland had very few, the number being one thousand to fifteen hundred a piece. Holland harbored about one hundred thousand, and half of these were crowded in the Ghetto of Amsterdam. France had eighty thousand. Italy had perhaps

FIG. 1. Routes of Migrations of the Jewish people and their approximate dates.

fifteen thousand. Scandinavia had persistently excluded the Jews. Toward the east and south of Europe the number of Jews decreased, particularly in Egypt and Palestine which had been the ancient centres of dispersion.

The main "centre of gravity" of the Jewish people in Europe of 1890 was in western Russia and Poland. The numbers of Jewish people expressed as percentages of the total populations of the various countries were as follows: The highest percentage, approximately 15%, appeared in Poland and Grodno. Most of the west Russian provinces had from 4 to 13%, while Hungary, Frankfort, and Holland showed 1 to 4%. Countries which were mainly agricultural such as Sweden and the Tyrol had less than 0.1%. These were the proportions of Jews in Europe toward the end of the nineteenth century.

In the American colonies the number of Jews amounted to two thousand by the time of the War of Independence. From 1881 to 1900 over six hundred thousand Jewish refugees from eastern Europe had landed in America. By 1904 the Jewish population of the country had risen to one and a half million and by 1930 this

figure was nearly trebled. At this latter date, 1930, the population of Jews throughout the world was approximately fifteen million (Roth 1936). By 1914 the Jewish population of America showed considerable grouping in the major cities.

The sojourn of European Jews during World War II, 1939 to 1945, has been recorded by the American Jewish Joint Distribution Committee of New York (1946). Almost six million Jews, it is stated, were wiped out in Europe during the six years of World War II. The Committee estimates that of every ten in Poland in 1939 only one remained alive in 1945. There were 3,250,000 Jews in Poland at the start of the War. At the end there were only 86,000. Many are found in Russia, Germany and Austria. Germany in 1939 had 240,000 Jews. The American, British, and French zones had a total of 72,000 Jews.

Estimates by the Joint Distribution Committee on the way Jewish populations dropped in the war years are as follows: In Belgium from 100,000, to 30,000; Czechoslovakia, 360,000 before Munich to 50,000; France, 300,000 to 180,000; Greece, 75,000 to 10,500; Holland 150,000 to 30,000; Latvia, 95,000 to 600; Lithuania, 155,000 to 20,000; Roumania, 850,000 to 335,000; Soviet Union, 3,020,000 to 2,000,000; Yugoslavia, 75,000 to 14,000.

In a few countries populations gained mainly as a result of the influx of refugees from war-torn areas. The number in England rose from 340,000 to 350,000; in Eirie, from 4,000 to 4,500; Italy, 51,000 to 52,000; Portugal, 3,500 to 4,000; Sweden, 7,500 to 22,000; Switzerland, 25,000 to 36,000. The Committee estimates roughly that 250,000 left the continent during the six years. Of these it says 112,000 went to the United States and Canada; 36,000 went to Latin America; 100,000 to Asia which includes Palestine, and 2,000 to Africa and Australia.

NATIONAL MISCIBILITY

The Jews are people without a country.[1] They wander, not gregariously in tribes, and often not even in families. They may scatter thousands of miles before striking root or becoming fecund. True, the Jews bunch together where ever possible, and this has often been necessary for self-preservation. Their enforced migrations and associations have changed them and their language. Forced of necessity to adopt the speech of their immediate neighbours they have evolved distinctive speech wherever they they congregate in large numbers. In Spain and the Balkan States they make use of the Spanish. In the interior of Morocco they speak Arabic, while in Russia and Poland a degenerate form of German has become Yiddish. Despite these difficulties they still constitute a distinctive social unit wherever they chance to be.

Furthermore in their migrations they have not suffered assimilation and absorption; on the contrary they have added greatly to their numbers by the absorptions of others in countries where Jews were alien. For instance in 1740 A. D. the Khan of the Khazars (who lived north of the Black Sea) was converted to the Hebrew faith, and subsequent mass conversions of these Alpine Asiatic-followers created a great admixture of the Jews, (Taylor 1938). To cite another similar instance one may mention the conversion of the Falashas of Arabia in Yemen.

In the early days of Judaism marriage with non-believers was not invalid, as it later became. Such irregular marriages with, and conversion of Christians are abundantly on record. Even despite prohibitive legislation, thousands of marriages with Christians are reported in Hungary in 1229.

Great importance was attached by the Jews to an early classification of themselves. The Polish types, an admixture of Hebrew, Hindu, and Khazar sources, still call themselves *Ashkenazim*, while the Spanish *Sephardim* alone were held to be truly Semitic. Which of these two was the primitive type of Palestine is a moot question, (Ripley 1899).

Thus the origin of the modern populations of the Jewish people is as diverse

[1]Israel, as a country belonging to the Jews, has been recognized officially only since 1948.

as the types of the various peoples that have been assimilated. Pittard (1927) states that the Judaized people have come from every kind of ethnic stratum, such as the Falashas of Abyssinia, and the Germans of Germanic type; or the Tamils—Black Jews—of India, and the Khazars supposedly of Turki race.

VARIATIONS OF PHYSICAL CHARACTERISTICS AMONG JEWISH GROUPS FROM VARIOUS GEOGRAPHICAL REGIONS

Pittard (1927) states that at the present time there is no single Jewish community in the world which has been genetically isolated from admixture with Jews from other communities since the period of its first formation. For this reason we cannot assume that any one group of Oriental Jews is fully representative of the Palestinian Jews of the time of Christ. If, however, we study the Jews of the Mediterranean world both separately and as a group, we should be able to find the common racial denominators which will reveal to us the physical characteristics of their united ancient Jewish ancestors. Let us begin with the present-day Palestine, where, although representatives of every type of Jew have come together, there is a complete historical continuity of Jews from the time of Christ.

THE MODERN SAMARITANS OF PALESTINE

The modern Samaritans of Palestine who are generally supposed to represent the indigenous Palestinian strain more faithfully than any other, are tall with a mean stature of 173 cm. (Huxley H. M. 1916), and mesocephalic (C. I. 78) with heads similar in dimensions to both Yemenis and Mesopotamians. Their faces are moderately long (125 mm) and narrow, while their thin foreheads are of moderate breadth (103 mm). Their noses are leptorrhine (N. I. 66) and of moderate dimensions.

In pigmentation the Samaritans show more than the usual Mediterranean 25 percent of partial or incipient blondism. Only seven out of 35 had black or dark brown beards, the rest were brown, blond and red. In eye-color one-third were light or mixed; the rest were equally divided between dark brown and brown.

The general body of Oriental Jews, however, is less tall and less blond than these comparatively specialized and inbred Samaritans. Weissenberg (1915) in a general series of Palestine Jews found no blondism, and the short stature of 159 cm., combined with the mean cephalic index of 79.8 extremely narrow faces (128) mm), and a nasal index of 61. Convex noses of a type which he designated as "Semitic" are found in 78 percent of his series.

THE YEMENITE JEWS OF SOUTHERN ARABIA

The Yemenite Jews of southern Arabia form the only large colony of this people in Arabia. Here the city Jews of Sanaia are for the most part short slender people, light-skinned but purely brunet in hair and eye-color. The commonest shade of hair is black, and of the eyes dark brown. In stature and in cranial and facial dimensions they resemble the Palastinian Jews greatly, except that the brachycephlic element is almost entirely lacking: The mean cephalic index of the Yemenite is 74. Their faces are small with a total face height of under 120 mm., and a bizygomatic of 130 mm. In Weissenberg's series 60 percent had straight nasal profiles, and a few even concave.

There are two types of Jews among the Yemenite group. The more numerous is only moderately slender, often well muscled in the extremities. The face is short and of moderate breadth, the chin well developed, lips of medium thickness. The nasion depression is medium, and the browridge noticeable, but not heavy. The eyebrows are thick and convergent, the eyes deep set and the palpebral opening is sometimes narrow. The second, less numerous type is lighter in weight and slenderer with small hands and feet, an extremely narrow head, projecting occiput and a sweeping curve for the forehead in profile. The face is long and very narrow, the mandible slender, the lips thin, the nasal tip somewhat depressed, the nose

extremely long with compressed wings and the nostrils highly set on the sides. Although the nasal profile is convex, the bridge of the nose is not unusually high. Both types are almost purely brunet in hair and eye color; both are brunet-white in skin color. The first type is somewhat heavily bearded, while in the second facial hair is usually sparse. The Jewish appearance of the coarse type is concentrated in the eyebrows, eyes, and mouth; of the fine type in the nose.

Coon (1939) states that although there is no doubt that much local blood was absorbed into the Jewish community by conversion in the pre-Islamic days, it is not difficult to distinguish a Jew from an Arab in Sanaia, a city of Yemen. Two other characteristics which occur among Jews are a high attachment of the nasal

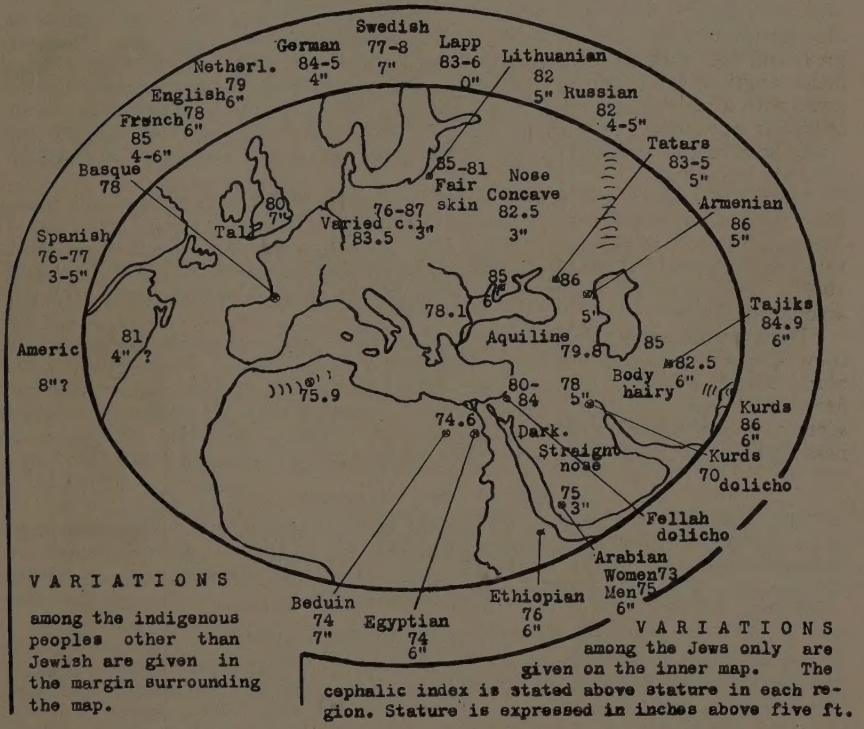

FIG. 2. Variations of physical characteristics of different Jews compared to the traits of the indigenous peoples of various geographical regions.

wings on the cheek with a great lateral visibility of the septum, and a characteristic slant to the ear in both the frontal and lateral planes. In addition to the features listed there seems to be a characteristic facial expression, a Jewish facial behavior centred about the eyes, nose and the mouth.

THE NORTH AFRICAN JEWS

The North African Jews are on the whole taller than those of Palestine and Yemen, with a mean stature almost uniformly between 164 and 166 cm.; their cephalic index is 74, and very few are brachycephalic. No more than five percent show evidence of blondism.

THE JEWS OF TURKESTAN AND AFGHANISTAN

The Jews of Turkestan and Afghanistan are fully brachycephalic, with a mean cephalic index of 85. They are of moderate stature, 166 cm., nearly the same as the Tajiks among whom they have lived for over a millenium. But they are narrower-shouldered than the Tajiks, shorter-trunked, and longer-legged; their bodily proportions preserve more of a Mediterranean racial character. Their heads are short, 180 mm., narrower than those of the Tajiks, with a mean breadth of 153 mm. Despite their brachycephalization they have preserved distinctive traits of face; their minimum frontal mean is 104 mm., their bizygomatic, 139 mm., and bigonial 104 mm. Thus they are narrower in all three dimensions than their non-Jewish neighbors, but a little wider in the essential facial diameters than the long-head Jews. Their interorbital (31.3 mm) and biorbital (90.9 mm) diamteres are narrower than those of other central Asiatic peoples; they have thus also preserved the original Jewish narrowness between the eyes. Their faces with a mean length of 125.4 mm. are two mm. longer than those of their neighbors; their noses with a mean length of 57 mm., are also two mm. longer. Their facial index of 90.5 is leptoproscopic, their nasal indexis 62, which is three to four points lower than those of the narrowest noses of the other peoples of Turkestan with whom they are in contact.

Metrically therefore, it would be wrong to infer from the cephalic index alone that the Jews of Bokhara, Turkestan, are simply Judaized Tajiks or Judaized Turkestan people in general. "What they actually are is brachycephalized Jews, who have preserved their Mediterranean facial characters almost intact." (Coon 1939). The agent of brachycephalization is the same Alpine element as exists among the Tajiks.

They are almost all brunet-white in skin color, lighter than the Tajiks; in eye color 57 percent are purely brunet and mostly light brown. Fifty percent have black head hair; fourty percent have dark brown hair; and another ten percent brown to blond. In their general pigment character they are approximately the same as the mountain Tajiks, but lighter than those of the oases. They are as heavily bearded as the Tajiks and as abundantly supplied with body hair.

JEWS OF THE CAUCASUS

The Jews of the Caucasus are highly brachycephalic with cephalic indexes of 85 and 86. Their mean stature ranges from 163 to 166 cm., and their faces are broader than those of the Bokharan Jews. They are however, still extremely leptorrhine, and have straight or convex nasal profiles.

THE KARAITE JEWS OF THE CRIMEA

These Crimean Jews have a stature of 164.5 cm., their mean cephalic index is 85, and the nasal index is 60. Five percent are light in complexion. Karaites living outside the Crimea have failed to preserve their characteristic metrical position. Those who settled in the Egyptian Delta have a cephalic index of 74.6, while those of Lithuania have a cephalic index of 81, and a stature of 162 cm.; fifty five percent have fair skin color and an equal amount of mixed hues. Over fourty percent have also brown or light brown hair color. Concave noses, the antithesis of a Jewish condition, are found among fifty percent while nasal convexity is almost entirely absent.

THE ASHKENAZIM JEWS

Ashkenazim Jews seem to show that characters such as stature may be environmentally and socially conditioned. In western Europe mean statures for regional groups vary from 162 cm. to 167 cm. In a rough way the stature level corresponds to that of the local Gentiles, but is one or two centimeters lower in each region. In Europe indoor workers have the smallest statures and professional men the tallest. In England where the Jews have enjoyed relatively favorable living

conditions the stature rises to high levels. Rapid dize increase on American soil, in response to better living conditions, may be partly interpreted as a fulfilment of their genetic possibilities. Similarly inferior chest diameters of the East European Jews are seen to rise to non-Jewish standards in America.

Head form of the Ashkenazim is relatively constant. In Germany the mean cephalic index for Jews is about 81, rising to 83.5 in Baden and Galicia, and in Bukovina it attains 84, but elsewhere from Austria to the Ukraine and Lithuania it centres about the mean of 82. There appears to be slight tendency for the cephalic index to vary regionally as does that of the corresponding Gentiles. Generally in central and eastern Europe Jews are less brachycephalic than the Gentiles.

Pigmentation of the Jews shows constancy. Approximately fifty five percent are of dark hair and eye color combinations, and less than ten percent can be construed as blond. In countries where the Gentiles are predominantly blond, the Jews are relatively dark; and in countries such as Roumania, where the Gentiles are prevailingly brunet, the Jews are more blond than the Gentiles.

Convexity of nose, a popular diagnostic of Jews, is usually found in far fewer than fifty percent; straight noses are in all regional Jewish groups the commonest profile forms, while in southern Russia concave profiles are more frequent. Among Russian Jews it is not difficult to select individuals with large malars, broad snubbed noses, and high alveolar segments of the upper face, who are as nearly Mongoloid as many Volga Finns.

Among German Jews may be found individuals who are to all purposes Nordic, and others who belong to the Borreby race, which is the most numerous single type among Gentiles in Germany. Alpine Jews are commoner than the incidence of Alpines in central and eastern Europe would perhaps warrant, and some of their Alpinism must have been derived from their sojourn in France and in the Rhineland before their march eastward across central Europe. On historical grounds it is very likely that the ancestors of the Ashkenazims mixed more with the Gentiles in western Europe, before the time of the first Crusades than their more recent forebears have in Slavic countries. The heavy beard growth, the abundance of body hair, and the wavy hair form of many brachycephalic Jews imply a French or German Alpine infusion.

The Jewish people as a whole represent a blend of several or many of the racial types discussed which in a subtle manner gives them the Jewish appearance.

The central European Jews have lived in central Europe since the beginning of the period when the Germans and Slavs began to grow brachycephalic. Their recent racial history has run parallel in time to that of their Gentile neighbors, in comparison with whom they must have remained relatively constant. The modifications which the Jews have undergone in one generation in America are as great in some respects as those which have affected their ancestors in twenty. (Boas 1913 Morant and Samson 1936).

SUMMARY

A study of the main physical characteristics of the indigenous stocks of various regions and the corresponding characteristics of the Jews that have lived among them in these regions indicates that the Jews are of heterogeneous types each of which conforms to a greater or smaller extent to the indigenous physical types. The following examples can be located with greater clarity by observing Fig. 2.

1. The stature, cephalic index, and abundance of body hair among the Jews of the Turkestan runs almost parallel to the same characteristics which are common to the indigenous Tajiks.
2. The strong brachycephalization and medium stature of the Jews of the Caucasus is almost the same as that of the Tatars who are at home in this region.
3. The heavy hooked nose of the Jews of Asia Minor or Turkey has its equal among the Armenians.

4. The dolichocephalic condition of the Jews of Egypt is very similar to that of the native Egyptians and Beduins.
5. The frequency of fair skin and head hair among the Jews of Lithuania is not surprising among the Lithuanians.
6. The dark complexion and straight nose among the Jews of Arabia as well as their cephalic index of 75, is common among the Arabs. In the southern part of Arabia at Aden the Arabs consider the native Jews as part of themselves.
7. The high percentage of concave noses among the Jews of Lithuania and southern Russia is not a Jewish characteristic among Jews of the homeland, but it is a characteristic of the Russians.
8. In England the stature of the Jews has surpassed that of almost any other group of Jews elsewhere.
9. In America the cephalic index of the Jews has been proved to undergo changes which help to understand the possibility of similar changes in other geographical regions.

What may the causes be that bring about these differences among the Jews? An explanation that would not violate the present knowledge of Genetics is that the indigenous peoples that have become assimilated by the Jews in various geographical regions have contributed their genes to the present inherent Jewish genetic make-up. That assimilation of even large numbers has occurred is undeniable. Another explanation that gains support in recent researches (Boas and Weidenreich) is that of persistent regional modifications due to improved conditions in occupation, nutrition, and climate. If perceptible changes in physical stature and cephalic index are evident as a result of a few generations under new conditions two hundred to a thousand years must surely leave their mark.

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CULTURE CHANGE IN LOMA: A PRELIMINARY RESEARCH REPORT[1]

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"Loma," "Justino" County, Southwest, is a relatively isolated community of some 200 people (40 families). Most of them are Spanish-speaking; the rest are "Anglos," non-Spanish, English-speaking "Whites." The community lies 7,000 feet high, in a little valley stretching across a state road, which, in rainy weather, it is a special art to travel.

Almost all Spanish persons were born in Justino County, and a majority in Loma itself. The Anglos are much more heterogeneous in this, as well as in many other respects; even occupationally: one is a trader and store owner, his wife running the post-office; another rents cabins; but all also farm. The Spanish people make their living farming and doing wage work outside Loma (most of them combining both), especially sheepherding, sheepshearing, and potato picking. Land is the chief property. Anglo acreages and values are higher than Spanish, but there is much variation within each class.

For about 40 years, Loma has had a public grade school. The church (Catholic), only some ten years old, is a "mission" of the Justino parish. Mass is held once a month, not on a Sunday, by an Anglo priest. The Anglos belong to various non-Catholic denominations, or to none.

People look lean, and many are bony. At least the Spanish diet is deficient. Sickness is widespread. Much of it is undiagnosed. Infant mortality is high. Birth control is practically unknown.

Loma history has few specific dates. Some tenants lived in the locality as long as 120 years ago. Water rights were granted by the Mexican government. Soon the first irrigation ditch was dug; and about 60 years ago, an Anglo pioneer dug the first well. The most far-reaching event was the establishment of the National Forest early in this century. It eliminated sheep and goats by pre-empting grazing lands and pasture, thus depriving the Lomans (*Lomeños*) of basic sources of income: of meat, milk, and cheese for food; of wool for spinning and weaving; and, indirectly, of spinning, weaving, and related skills. The next important change factors, more difficult to date, were the introduction of the automobile and the less directly significant contacts with other urban inventions—

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[1]This paper, read at the Twenty-fifth Annual Meeting of the Central States Branch, American Anthropological Association, Indiana University, Bloomington, May 13 and 14, 1949, is a very concentrated synopsis of some parts of a large-scale monograph on Loma designed to develop and document a conception of social science, especially sociology and cultural anthropology, and particularly, the study of culture. (Other parts of the monograph already published are: "A Methodological Note on the Empirical Establishment of Culture Patterns," *American Sociological Review*, 15: 10: 176–184, April, 1945, and "The Unique and the General: Toward a Philosophy of Sociology," *Philosophy of Science*, 15: 192–210, July, 1948.) Field work in Loma was done in 1942 and 1944; in 1944, on a Social Science Research Council fellowship. Writing up was begun in 1948 and 1949 under grants from The Viking Fund, Inc., and the Graduate School of The Ohio State University. In the summer of 1947, a graduate student spent several weeks in Loma under the joint supervision of Dr. John W. Bennett and myself (all of Ohio State University); material collected by this student is part of the sources utilized here, as well as in the first volume of the monograph written up thus far. To these organizations and persons I gratefully acknowledge my indebtedness.

This paper, probably, will appear to be largely impressionistic, due overwhelmingly, if not wholly, to the impossibility of anything more than very slight documentation, in view of the time limitations under which it had to be presented; even the methodology employed could be indicated, if at all, only by implication. Reference for full documentation must therefore be made to the forthcoming monograph.

radio, magazines, dance halls with their nickelodeons in Alta (the nearest community to the south), the movie in Justino, and latest, electricity. In most of these diffusions, federal and county agencies and the Loma Institute were instrumental.

The defunct Farm Security Administration was the most important federal agency economically and, in conjunction with other farm-improving services, for reforms in agriculture as well. People recognized this: the FSA made more sense to them than did any other effort. Individuals who benefited from it also rated WPA highly. The Soil Conservation Service has met with some interest, but most of the plans discussed in connection with its District have not yet materialized. The County Agent, according to the individual who occupies the office, may function as merely one of the numerous vague entities called "government officials" or as an intimate friend and adviser.

Justino, the seat of all these and other governmental agencies, also houses the tax authorities. On the whole, they are felt to be functionaries of a vast and fateful power. In 1940, more than half the farms in the county had become the property of the state for back taxes, often without the knowledge of the original owner. For Loma, the figure may be as high as one-fourth. In 1941, the percentages which taxes represented of incomes ranged from one to 75.

Directly or indirectly, the agencies try to introduce a foreign-imposed type of community organization of a non-traditional, non-religious, non-feudal, non-Spanish type. Yet it was the Justino Plan and the Loma Institute which were most intent upon improving conditions by rational measures. The Plan, which operated for about three years during the early 1940's, obtained "problem lists" from representatives of all communities in the county. It cooperated with the other agencies, public and private, and with the people in the communities themselves. In Loma in 1942, the most urgent problems, according to the residents, were water scarcity, with the building of a reservoir and the adjustment of ditches given highest rating as suggested solutions; inadequate education, with additional teachers named as a measure of improvement; and poor health. The Justino Plan did various things in regard to these and many other problems, and ever since its demise, several efforts have continued.

The Loma Institute, created and directed by a midwestern Anglo teacher and his wife, was more intimately connected with the community directly. It developed through money gotten together by means of summer camps, frequented by boys and girls from as far away as New York. Later, a year-round grade and high school was run, mainly with local Spanish students. Due to the scarcity of personnel, decimated by military service, and to shifting interests on the part of the few individuals left, the Institute altogether lasted only five years. Yet while running, it was engaged not only in formal education but also in various other community activities, such as the 4-H Club, health clinics, the establishment and supervision of a community center, dances, and the like. Aside from direct give and take, the most outstanding means of communication between the Institute and the community was a newspaper, *The Lomeño*. Written and mimeographed by staff and students, it gave expression, particularly, to the Institute's emphasis upon participation in political life, local, county, state, and national.

In spite of these efforts, however, planning and organized cooperation in matters where they were not traditional (as, for instance, in irrigation) remained foreign to the people. Here, however, the narrative must be interrupted, in order to insert a methodological note or, perhaps, to confirm an observation made by the reader, namely, that what has been said thus far refers mainly to the Spanish people of Loma. Beyond showing this awareness, it is not possible to do more than to point out, rather peremptorily, that the reason for this preferential treatment is Loma's being a predominantly Spanish community, in more than one respect, and to state that from now on, the Spanish society and culture of Loma exclusively will be dealt with. To resume the argument, then: how much planning and organized cooperation remained foreign to the *Lomeños* is suggested by the

answers to questions concerning their community, asked of them in 1942. One question was: "How much land do you think is needed for raising enough animals and crops to supply yourself and your family without having to go outside for wage-work?" Answers to it ranged from 15 to 250 acres. Another was: "Given the cultivable land and the water available, how many families do you believe can make a living in Loma without having to go outside for work?" Replies ran from two to 25 families. Still other questions resulted in comparable answers: all showed polite compliance with the type of request that was made, but did not go beyond this, toward a more empirical preoccupation with the topics brought up.

Almost all that has been said illustrates Loma culture change. Anglo-carried phenomena—economic, technological, industrial, urban—act upon a culture formerly not so impressed. This impact is both local and pervasive. (Cf. Fig. 1.) Among the local elements, in chronological order, are Anglo-derived education, the National Forest, the Anglo-operated trading post and store, the post office, the

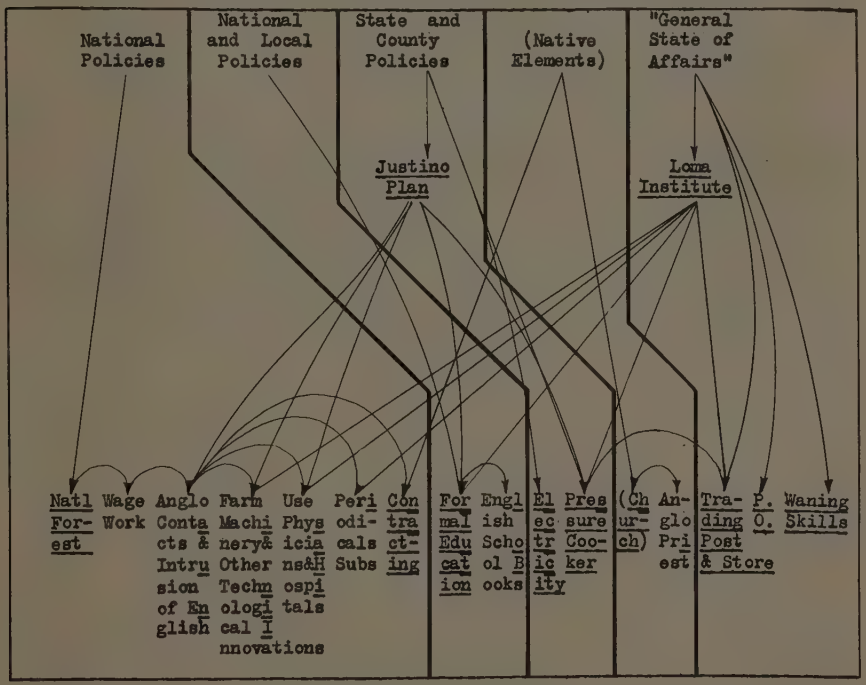

FIG. 1. Elements in the Process of Loma Culture Change. The top line lists influences (whose preponderant direction is indicated by arrows) outside the local change system, with the possible exception of the vague last, "General State of Affairs." The bottom line lists elements operating in the Loma culture as of 1948 (and thereafter). These elements are shown in their connections with one another, as well as with the influences listed on the top line. Two elements (Justino Plan and Loma Institute) are placed in an intermediate position to indicate that they were no longer in existence in 1948. Underscoring indicates the fact that the item can be traced only to an influence outside the local change system; non-underscored items can be traced to influences within this system. The—undoubtedly existing—influences of items on the bottom line are not indicated except for a few specific ones (the chain leading from National Forest to Contracting; the introduction of English School Books through Formal Education; of the Anglo Priest through the Church; and of Pressure Cooker and Post Office through the Trading Post and Store). The parentheses around "Church" indicate that this element is native.

Anglo priest, and the short-lived Justino Plan and Loma Institute. More pervasive elements, in approximately chronological order, are the intrusion of English and of English school books, the appearance of outside wage work, the waning of handicrafts, contracting farm machinery the use of physicians and hospitals, the introduction of sewing machines, pressure cookers, and other household appliances, of magazine and newspaper subscriptions, and of electricity.

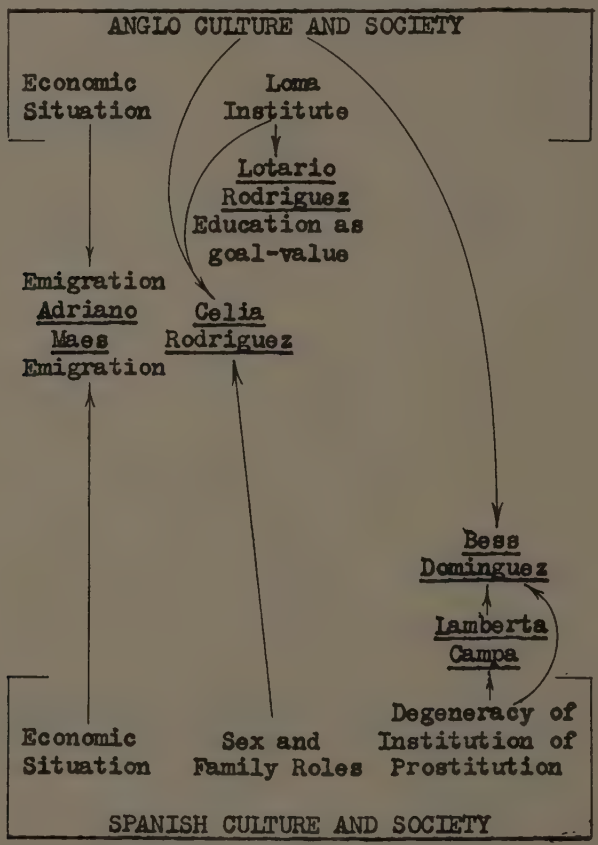

FIG. 2. Elements in the Process of Culture Change on the Part of Five Lomans. The positions of the five individuals diagrammed symbolize their respective "nearness" to Anglo and Spanish culture and society, respectively. Arrows indicate preponderant direction of influence.

In a much more intimate fashion, the process of this change is shown in life histories (see Fig. 2) and in compositions written by upper-grade school children. Lotario Rodriguez, a twenty-year old boy who graduated from the state university (thus far the only Spanish Loman to do this), exemplifies a change of Loman culture through the incorporation of (Anglo) education as a goal-value. Another type results from socio-economic change. It is illustrated by several young married men, for instance, Adriano Maes, who emigrated, probably for good, preponderantly on economic grounds. A third type, perhaps, is represented

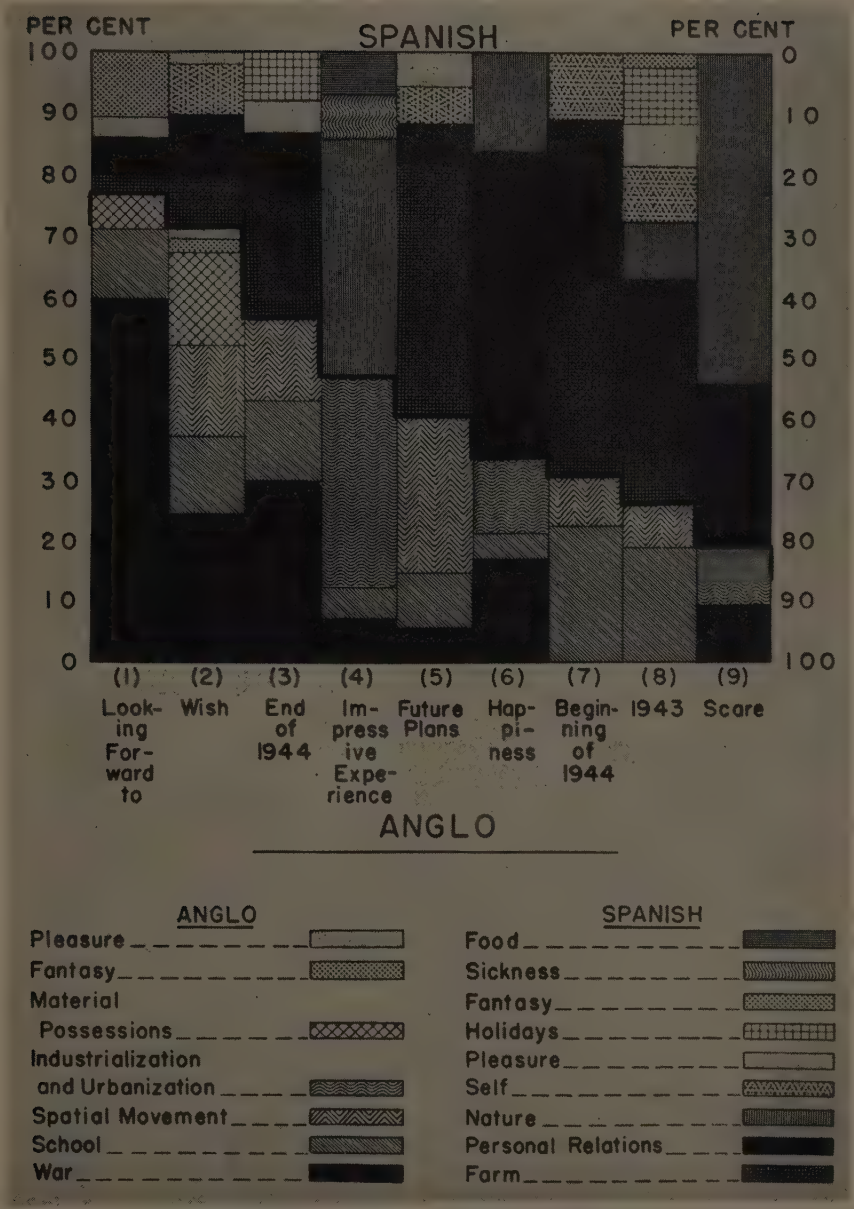

FIG. 3. Percentages of Anglo and Spanish Components of Responses by School Children to Nine Stimuli: Loma, 1944.

by Lotario's younger sister Celia. While her brother may be said to participate in two worlds, Spanish and Anglo, Celia's outlook seems little Anglicized in spite of her equally good English and other "participations" in American culture. In part, this is due to her being a girl. As her most impressive experience, she recalled the onset of menstruation and the fatal accident of a younger sister—whereas the brother's most fundamental change, as interpreted by him, consisted in the process of education; and he did not even mention the sibling's death. Finally, there are two persons, mother and daughter, Lamberta and Bess, whose lives are almost exclusively definable in terms of a decaying institution—prostitution, which may be presented as the Lomans' handling of one component of human nature —evil, especially sex. Lamberta, the mother, although she has initiated a large number of boys into the sex act, is treated like any other villager, in a friendly, ordinary manner. But her role is no longer stable and clear: Lamberta is cautious, diffident, confused. Furthermore, while she emphatically asserts her complete agreement with church doctrine, including confession, her daughter, as yet unmarried, favors divorce, uses the expression "none of the priest's business," prefers Anglos, would like to marry one, is strongly attracted by the "city" but at the same time attached to her mother and the "folks." She has no longer any idea of "human nature," whereas her mother is still bewildered by it—already bewildered by it, if in turn, Lamberta is seen against the past.

The children in the fifth to eighth grades were asked (by the substitute Anglo teacher) to respond to the following stimuli: "What are you looking forward to?" "What do you wish for most?" "Make a calendar for the rest of this year (1944)." "What made the greatest impression on you?" "What are your plans for the future?" "Describe when you were most happy." "Make a calendar for the past part of this year." "Make a calendar for last year (1943)." "Describe when you were most scared."[2] The answers to these questions were analyzed in regard to Anglo and Spanish components posited, on the whole, on the basis of an "image" of Loman culture which had been gathered by staying in the community and which is subject to checks yet to be applied. The list just given is in the order of decreasing Anglo percentages. (Cf. Fig. 3.) In the "looking forward to" question, they amounted to 77 per cent, the then current war figuring overwhelmingly. Next (72 per cent) came the "wish," with the war likewise preponderant, but with a close-by tie between desires for spatial movement, mainly trips, and material possessions. Next (57 per cent) came the calendar for the end of 1944, with war once more strongly in the lead. Next (46 per cent), the "most impressive experience," with the reflection of industrialization and urbanization in various respects being clearly prominent. Next (40 per cent), "future plans," with spatial movement outstanding. Next (33 per cent), "happiness," with the war slightly surpassing industrialization and urbanization. Next, the calendars of the past part of 1944 (30 per cent) and of 1943 (26 per cent), with school experiences ranking uppermost; finally, 18 per cent of the children's "scare" memories were Anglo components, equally connected with the war and with aspects of industrialization.

Of the complementary Spanish elements, fantasy was most important in the 23 per cent of the "looking forward to" question; personal relations, in the 28 per cent of the "wish"; farm matters, in the 43 per cent of the calendar for the end of 1944; nature, in the 54 per cent of the "most impressive experience"; again farm matters, in the 60 per cent of the "future plans"; personal relations, in the 67 per cent of "happiness"; the farm once more, in the calendars of the

[2]A good deal of explaining was necessary to make these questions understandable. This, along with the class-room context, the teacher's personality, and similar factors, made for an important situational impact upon the answers which, however, could not be measured. A consideration such as this is only one among many which went into the technique of analyzing the children's answers in regard to Spanish and Anglo components. The technique cannot be described here.

past part of 1944 (70 per cent) and of 1943 (74 per cent); and nature, in the 82 per cent of the "scare" memories.

If the overpowering contemporaneous event, World War II, as well as all items amounting to less than three per cent each of the components in either the Anglo or the Spanish class, are eliminated, the children's answers can exhaustively be classified into three Anglo items, totaling 37 per cent of all components, namely, the school, spatial movement, and industrialization and urbanization; and into four Spanish items, totaling 63 per cent, namely, personal relations, the farm, nature, and the self. The Anglo components reflect, respectively, interest in an institution, expressions of attitudes, and impacts of a process. The Spanish components reflect social relations ("personal relations" and, as an inspection of the children's answers indicates, "self") and institutions ("farm" and "nature"[3]).

The analysis of culture change has thus led to a confrontation with Loman culture itself. As this culture emerges from an analysis of the children's compositions, and from the life histories, it would appear to be a culture which, in the way described, has both Anglo and Spanish components. But this statement anticipates a good deal. For it is based, also, on answers to questions which have not been discussed here, as well as on the largely unknown impact on the answers given, an impact called forth by the situation in which the questions were asked. The validity of statements concerning Loman culture can be increased only if it is possible to formulate them in a less tentative and more intelligent and justifiable fashion. This, in turn, can be done only if Anglo-Spanish relations are more intimately studied—if, that is, the structure of the Loman social system is better understood.

At this stage of analyzing the data, neither this nor the many other things that need being worked out and clarified have been done. What has been presented, therefore, stands pending the solution of these tasks, since it has been elaborated to the point, it would seem, where it can be revised only upon their completion.

[3]By "institution" is understood, here, a unit, within a socio-cultural context, which contains social and cultural elements (individuals and their relations, and their interpretations) and which also may contain elements of the natural environment; a unit which must "be counted with" by the participant individuals. It may be suggested that while in Loman culture, Nature is an institution in this sense, it is not an institution in the typical urban culture, although it is one (with, however, variable contents), perhaps, in rural culture generally, and very probably, in the Anglo culture of Loma.

ATTEND THE

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VOLUMETRIC AND GRAVITY SLIDE TESTS FOR AIR-BORNE RAGWEED AND OAK POLLENS AT COLUMBUS, OHIO

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A more or less recent phase of atmospheric pollen research has been concerned with deriving a mathematical formula or a conversion factor with which gravity slide data[2] could be converted into equivalent volumetric units. Data so reported would be of greater value to allergists since the degree to which a patient is sensitized greatly depends upon the number of antigenic pollen grains entering the individual's lungs. Scheppegrell (1) in 1917, reported a conversion formula (partially derived by use of Stokes' law of falling bodies) for converting data obtained from freely exposed[3] gravity slides into equivalent volumetric units. Cocke (2) later corrected a mathematical error in the formula, and both Cocke (3) and Hawes (4), following simultaneous gravity slide and volumetric tests, reported that their experiments proved the validity of the use of the Scheppegrell-Cocke formula even when the specific gravity of the various pollens was considered as 1.0. However, Rosendall, *et al* (5), reported that the factors derived from Scheppegrell-Cocke formulas were also incorrect in certain instances. Dahl (6) then pointed out the inadequate knowledge concerning the specific gravity of the various pollens, and suggested that the assumption that this was approximately 1.0 might be incorrect and have a great deal to do with the apparent inaccuracies of the Scheppegrell-Cocke formula. He also pointed out that little was known concerning the relative rates of fall of the various pollens and suggested that no further progress could be made with the problem until the actual specific gravity of the pollen grains of different species, as well as their particular rates of fall in still air, could be determined experimentally. This information was supplied by Durham (7, 8). He found that the specific gravities of tree pollens are approximately 0.9, and those of most grass pollens are about 1.0; however, the specific gravity of ragweed pollen is approximately 0.5. Consequently Durham stated ". . . that calculations already made by Scheppegrell, Cocke, and Dahl, who have used Stokes' law for determining the rate of fall and number of pollens per cubic yard of air, may be expected to give reasonably accurate results for some tree and grass pollens, whereas they are evidently in error for the ragweeds."

The next step was to calculate theoretical atmospheric pollen concentrations by the use of the Scheppegrell-Cocke formula in which the experimentally determined specific gravities were included, and then compare these data with the actual concentration as determined experimentally. This was also done by Durham (9). He found great differences in the daily ratios as determined by the two methods, and concluded that ". . . the Scheppegrell-Cocke-Dahl tables are of no practical value in converting gravity slide figures to accurate volumetric equivalents." Durham's volumetric determinations were known to be essentially correct, therefore the large differences in the comparative ratios must have been the result of large errors involved in the gravity sampling procedure. This was in many instances verified by his data which indicate that on days of approximately the same degree of atmospheric ragweed pollen concentration the catch

[1]Paper from the Department of Botany and Plant Pathology, The Ohio State University, No. 514.

[2]Data collected by the use of sticky coated microscope slides exposed to the atmosphere for a given period of time.

[3]That is, slides in no way sheltered.

on the freely exposed slides usually varied directly with the wind velocity. Durham also exposed a set of gravity slides in various positions and found that a slide placed in a horizontal position with the coated side down collected approximately half as many pollen grains as a horizontal slide with the coated side upward. This led Durham to conclude that convection currents, deflection currents, and wind eddies must interfere with a horizontal flow of air hence with the deposit of pollens and spores on the gravity slides. Since the gravity slide method of sampling is by far the simplest and most convenient method so far devised, Durham proceeded to construct a collector which would decrease the turbulence over the slide and consequently result in a more uniform collection of pollens (10). Simultaneous gravity slide and volumetric collections were made during the ragweed season of 1945 using this new gravity slide sampler, and the comparative ratios were found to be much more uniform. The catch per cubic yard averaged 3.6 times greater than the catch per square centimeter of gravity slide, and Durham submitted this as a conversion factor for calculating the volumetric incidence of ragweed pollen when this type of sampler was used in areas where short ragweed is predominate. He further concluded that conversion factors for other pollens would be comparable to that of short ragweed in proportion to their relative rates of fall, and on this basis presented a table of conversion factors for some 40 important etiologic hay fever pollens.

The purpose of the volumetric studies reported herein was to obtain a better understanding of the atmospheric concentrations of ragweed and oak pollens at Columbus, Ohio, as well as to check the feasibility of using Durham's conversion factors for volumetric incidence determinations in this area.

VOLUMETRIC APPARATUS AND TECHNIQUE FOR COUNTING POLLENS

The volumetric apparatus (Fig. 1) used in the following experiments was operated approximately 60 feet above the ground at the edge of the flat roof of the Botany and Zoology Building of The Ohio State University.

By the passing of air through a glycerin-water-alcohol solution,[4] the pollen grains are trapped and the sampled air is metered. Pyrex test tubes, 32 by 200 mm., hold the collection solution, while others of the same size catch any of the solution escaping the collection tube. Air enters the system through a three and one-half inch pyrex funnel which is connected to a three and one-half inch length of ⅜-inch diameter butyrate tubing. The end of this tubing is perforated with 12 one-millimeter holes to break up the air stream. Glass beads in the collection tube further break up the air stream and consequently result in a greater washing of the air.

At the completion of each volumetric test, the complete collection unit was taken into the laboratory where the trap tube and funnel were washed with a small amount of water which in turn was added to the collection solution. This solution was then removed from the collection tube. The glass beads were washed several times with several milliliters of water, and the wash added to the collection solution which was then measured for total volume. After removing the washed beads, the solution was replaced in the collection tube for storage until counts of the trapped pollen grains could be made.

A Rafter Counting Cell, which holds one-milliliter of solution, was used to determine the approximate number of pollen grains collected during each test. All counts were made with a 10X objective in conjunction with a 12.5 ocular. In all instances at least three one-milliliter aliquots were observed for trapped pollen grains, and in cases where the first three counts were not approximately the same, additional counts were made until the average number of pollen grains per milliliter did not appreciably change. In the determinations of oak pollen abundance, one drop of a saturated solution of basic fuchsin was added to the

[4] 60% glycerin, 30% water, and 10% ethyl alcohol.

collection solution, approximately 40 ml., to facilitate counting. In all cases the entire counting chamber was observed, and all of the pollen grains were counted.

The efficiency of the apparatus to trap pollens was checked several times during the course of ragweed pollen sampling by placing a coated slide in the trap tube where it was adjacent to the entering washed air. Following each test, Calberla's staining solution (11) was added to the slide, and the area covered by a 22 mm. square cover slip was observed for pollen. In every instance the observed area was found to be free of pollen. The apparatus was further checked in the laboratory at the end of the ragweed season by directing a visible cloud of commercially dried ragweed pollen into the entry tube every 15 minutes over a period of two hours. A coated slide was again placed in the trap tube. Following the check the number of pollen

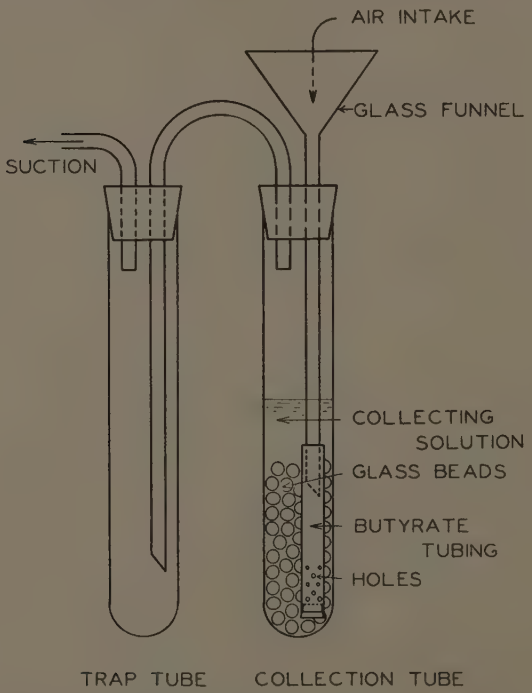

FIG. 1. Pollen collection unit of the volumetric apparatus.

grains in the collecting solution was approximately 150,000 while only eight were found on approximately five square centimeters of the check slide. It was therefore concluded that, for all practical purposes, when the apparatus was operating properly it was essentially 100 per cent efficient.

VOLUMETRIC AND GRAVITY SLIDE STUDIES OF RAGWEED POLLEN DURING 1948

GRAVITY SLIDE STUDIES

Four standard gravity slide collectors were erected at various locations within the city prior to the 1948 ragweed pollen season. One collector was located in the heart of the downtown business district on top of a six-story office building. Two collectors were placed in residential districts, one being located approximately two miles east of the center of the city in a back yard of a densely populated area,

while the other was located in a moderately populated and wooded district approximately six miles north of the central business district. The fourth collector was located on top of the Botany and Zoology building at The Ohio State University. Although the University district is only three miles north of the center of the city,

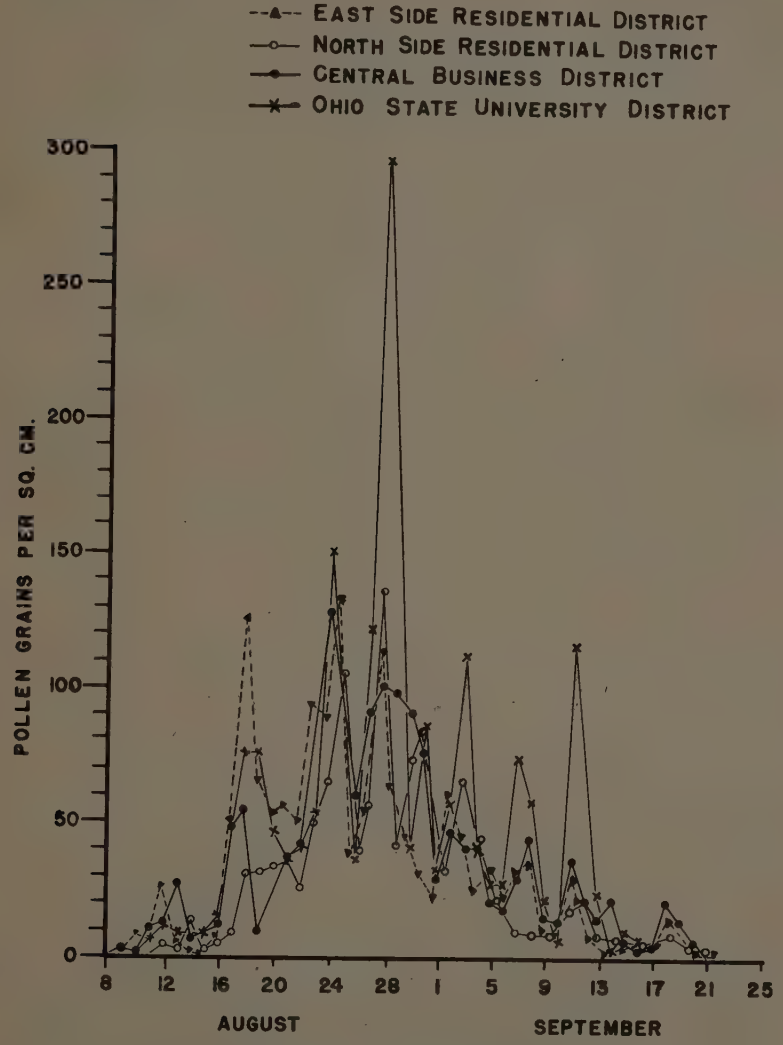

FIG. 2. The 1948 ragweed pollen season as determined from data collected in standard gravity slide collectors.

it is located near the city boundary, and open farming country lies immediately to the west and northwest. All collectors were held approximately five feet above their respective bases by ¾-inch rod standards.

Flowering of giant ragweed (*Ambrosia trifida*) occurred several days in advance

of short ragweed (*A. elatior*) and was first observed on August 5. Ragweed pollen was first collected by gravity slides on August 9, and by August 11 was being collected at each of the four stations. Omitting daily variations, mainly due to climatic fluctuations, the resultant frequency curves of all the stations indicate that there was a daily increase in the number of air-borne ragweed pollen grains until the period of August 24 to 29, during which time maximum concentrations occurred. There was then a rather steady decrease in the number of air-borne ragweed pollen, and by September 21 the daily catch at each station was less than five grains per square centimeter of gravity slide. The curves of the downtown and two residential stations are essentially the same, the maximum collection at each of these stations being between 126 and 132 pollens per square centimeter (Fig. 2).

The curve of the University station is similar to the curves of the other stations, but the daily collections are, in most instances, considerably greater. This is probably due to the predominate westerly and relatively unobstructed air movements from adjacent farming and river areas where extensive stands of both tall and short ragweed occur. As the velocities of these air movements are reduced by such obstructions as city buildings and vegetation, there is probably a dropping out of some of the pollen which results in lower collections at the stations other than the University station. The greatest catch at the University station was 295 grains per square centimeter of gravity slide and occurred on August 28.

The atmospheric ragweed pollen concentration, as it occurs over most of the city, can therefore be considered as a blanket of air in which the density of the ragweed pollen is essentially uniform. Consequently, the data collected by a standard collector located well within the city proper can be used to represent the atmospheric incidence of this particular pollen, as it occurs over most of the city. Data collected by a single collector during the tree and grass pollen seasons cannot be so used since the atmospheric abundance of these grains varies greatly between the downtown and northern residential districts.

VOLUMETRIC STUDIES

Volumetric determinations were made during 29 consecutive days of the ragweed pollen season beginning on August 19 and ending on September 16, 1948. At the latter date the concentration of these pollen grains was less than 100 per cubic yard of air (Fig. 3).

The weather during the greater part of the period of volumetric sampling was clear, hot to warm, and with little cloud formation or air movement. The eight days prior to the date of maximum concentration, August 30, were all cloudless, hot, summer days during which the maximum temperatures recorded at the local Weather Bureau were, in most cases, high in the nineties. The day of August 30 began as another hot, clear, quiet day, but by 10 a. m. thunderheads had developed, and at 12 o'clock a heavy thundershower commenced and continued for an hour. This was the first precipitation in 12 days, and marked the end of the hottest and driest summer weather of the year. A distinct daily fluctuation in the number of atmospheric ragweed pollen grains occurred during the first 10 days of sampling, days with a greater concentration of pollen being followed by days in which the concentration was markedly and proportionally less. Since the meteorological conditions during the first 10 days of sampling were similar, the days being cloudless, dry, hot, and quiet, during which the temperature regimes were much the same, it is suggested that this daily fluctuation may be due to some inherent factor of the ragweed species.

The maximum atmospheric concentration of ragweed pollen was slightly more than 10,000 grains per cubic yard of air, and occurred on the morning of August 30 immediately preceding the heavy thundershower mentioned above. Field observations substantiated the fact that this peak concentration was largely due to the flowering of tall ragweed. A second peak due to the flowering of short

ragweed was expected but failed to materialize due to the dessication of the majority of the flowers during the hot, dry weather prevailing in the latter part of August.

COMPARISON OF GRAVITY SLIDE AND VOLUMETRIC INCIDENCE DATA

Simultaneous gravity slide and volumetric incidence data were obtained during 29 consecutive days during the ragweed pollen season. However, during the first 14 days of testing the writer failed to expose one set of gravity slides *only* during the volumetric sampling procedure. Consequently, the gravity slide data for these days is of little comparative value. On September 3 this error in procedure was corrected, and the following comparative data were obtained during the remainder of the season (Table I).

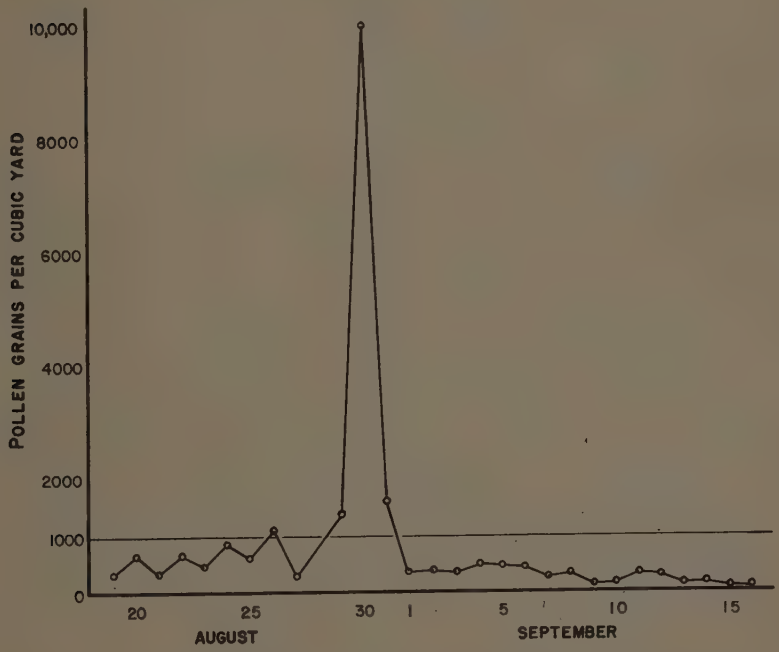

FIG. 3. Volumetric incidence of ragweed pollen at Columbus, Ohio (1948).

The gravity slide and volumetric data can be compared in two ways, (A) by determining the ratio of the total pollens collected by each method during the 12 days of testing, or (B) by deriving the average daily ratio of the pollens collected by each method. In this case the ratio of the total pollens collected by each method is 3.05, while the average daily ratio is 4.57. Durham used the ratio of the totals as the conversion factor, but in this instance the average daily ratio of 4.57 was found to give a more accurate conversion of the gravity slide data into equivalent volumetric units.

The conversion factor for giant ragweed, as calculated by Durham, is 3.87, and was derived from the experimentally-determined conversion factor of 3.6 for

TABLE I

CALIBRATION OF STANDARD SAMPLING DEVICE FOR GIANT RAGWEED POLLEN

Date	Volumetric					Gravity Slide						
	Vol. of Air Sampled cu. ft.	Pollen Grains per ml. of Solution	Vol. of Solution ml.	No. of Pollen Grains Collected	No. of Pollen Grains per cu. yd. of Air	Av. No. of Pollen Grains per sq. cm.	Duration of Tests Hrs.	No. of Grains Collected 24 Hr. Basis	Ratio Vol./ Gravity	Wind		Weather
										Dir.	Vel.	
9/3	33.1	12.0	38.5	462.0	376.8	15.9	4.2	91.4	4.1	S.	1–3	Clear in A. M.; Cloudy in P. M.; Warm
9/4	33 0	12.0	48.5	582.0	476.1	18.4	4.7	94.6	5.0	Var.	0–1	Clear, Hot
9/5	27.0	9.5	50.0	475.0	475.0	4.1	2.7	36.8	12.9	S. E.	4–7	Clear, Hot
9/6	20.5	8.0	44.0	352.0	463.6	6.0	3.3	43.9	10.6	S. E.	4–7	Cloudy, Rain
9/7	30.0	6.0	51.5	309.0	278.1	42.9	4.2	246.2	1.1	S. E.	4–7	Heavy shower in A. M.
9/8	37.0	10.7	41.0	438.7	320.1	18.4	4.3	101.9	3.1	S. W.	1–3	Clear, Warm
9/9	33.0	4.0	47.5	190 0	155.4	6.4	3.5	44.1	3.5	N. W.	3–6	Overcast, Cool
9/10	30.0	3.5	44.5	155.7	140.1	4.3	2.9	35.6	3.9	W.	2–5	Clear, Warm
9/11	43.0	12.5	42.0	525.0	329.6	50.7	4.7	260.1	1.3	S.	4–7	Clear, Warm
9/12	33.0	11.3	33.5	378.5	309.7	24.5	3.8	155.6	2.0	S.	1–3	Clear, Warm
9/13	34.0	5.3	42.5	225.2	178.8	7.9	4.5	42.1	4.2	Var.	0–1	Clear, Warm
9/15	30.0	3.3	31.5	103.9	93.5	3.7	2.9	30.4	3.1	Var.	1–2	Clear, Warm
Totals				3596.8				1182.7				
Ratio of Totals						3.04						
Average Daily Ratio								4.57				

short ragweed by taking into account the relative rates of fall between the two species. In doing this, Durham assumed that the number of pollens falling, or impinging upon, a gravity slide are in proportion to their relative rates of fall. Since the pollens of short ragweed were found to fall 0.93 times as fast as those of short ragweed, the conversion factor of 3.87 was obtained by dividing the conversion factor for short ragweed (3.6) by 0.93.

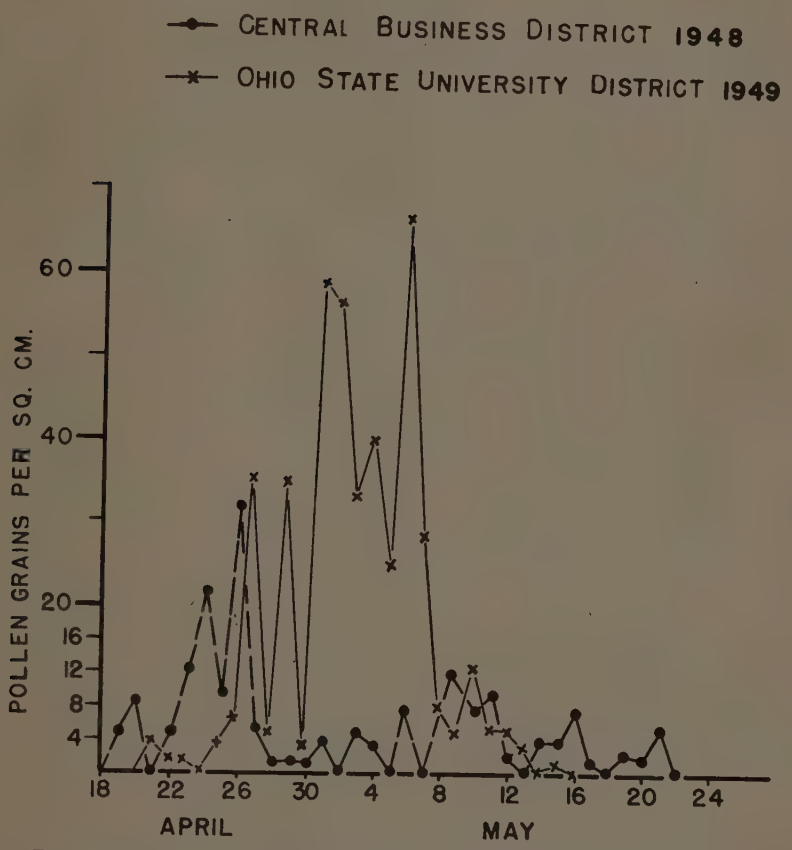

FIG. 4. The 1948 and 1949 oak pollen seasons as determined from data collected in standard gravity slide collectors.

This giant ragweed pollen conversion factor of 3.87 when corrected for the smaller size of these pollens in this area[5] is 4.68, and appears to compare favorably with the writer's experimentally determined factor of 4.57. It must be remembered that Durham's experimentally determined conversion factor for short ragweed is equal to the ratio of the total pollens collected by each method. Using the average of the daily ratios, his adjusted factor for giant ragweed pollen in this area would be 4.96. However, this factor is also considered to compare favorably with the writer's experimentally determined factor. It is therefore recommended that

[5]The average diameter of giant ragweed pollen in this area is 17.51 μ.

TABLE II

CALIBRATION OF STANDARD SAMPLING DEVICE FOR OAK POLLEN

Date	Volumetric					Gravity Slide			Ratio Vol./ Gravity	Wind		Weather
	Vol. of Air Sampled cu. ft.	Pollen Grains per ml. of Solution	Vol. of Solution ml.	No. of Pollen Grains Collected	No. of Pollen Grains per cu. yd. of Air	Av. No. of Pollen Grains per sq. cm.	Duration of Tests Hrs.	No. of Grains Collected 24 Hr. Basis		Dir.	Vel.	
5/2	153.5	2 28	41.0	93.71	16.48	6.19	10.5	14.16	1.16	W. to S. W.	8–12	Clear, Windy
5/3	156.0	2.33	35.0	81.55	14.11	5.57	10.7	12.51	1.13	N. W.	1–3	Clear, Hot
5/4	144 0	6.00	31.0	186.00	34.87	10.33	10.0	24.79	1 41	S. W.	1–3	Clear, Hot
5/5	123.0	6.00	33.0	198.00	43.46	6.40	9.0	17.07	2.55	N. W.	1–3	Clear, Hot
5/6	115.0	4.75	37.0	175.75	41.26	19.63	7 2	65.31	0.63	N. W.	1–3	Clear, Hot
5/10	165.5	2.66	40.5	107.73	17.57	9.09	10.5	20.62	0.85	N.	8–12	Clear, Cool, High Overcast
Totals					160.82			154.47				
Ratio of Totals						1.04						
Average Daily Ratio									1.29			

the conversion factor of 4.57 be used in those years when tall ragweed pollen is predominate, and that Durham's conversion factor for short ragweed pollen, corrected for size difference, be used when short ragweed pollen is the dominant type.

VOLUMETRIC AND GRAVITY SLIDE STUDIES OF OAK POLLEN DURING 1949

Locally, the most abundant oaks are white oak (*Quercus alba*), black oak (*Q. velutina*), red oak (*Q. rubra*), and pin oak (*Q. palustris*). However, shingle oak (*Q. imbricaria*), and burr oak (*Q. macrocarpa*) are also present within the city limits, or in the surrounding territory, and are probably minor contributors to the oak pollen concentration.

During three years of spring tree pollen sampling, pollens of the various oaks first appeared on gravity slides between April 16 and 21. Relatively high atmospheric concentrations during 1948, as determined from slides exposed at the downtown station, prevailed during the last week of April with a second minor peak occurring during the first three weeks of May. The greatest catch was collected on April 26 and was 32 grains per square centimeter. The 1949 season, as determined from slides exposed at the University station, began on April 21 and continued until May 11 with peak concentrations prevailing between April 25 and May 8. The greatest catch was collected on May 6 and was 67 grains per square centimeter (Fig. 4).

The early peak in the 1948 spectrum was due to an unknown oak pollen which was collected only in small quantities during the 1949 season. Since the 1948 peak occurred during days of relatively strong south winds, these unknown pollens probably originated in the southern portions of the state where chestnut oak (*Q. muhlenburgii*), scarlet oak (*Q. coccinea*), black oak and white oak occur in large numbers.

Comparative data were obtained by volumetric and gravity tests during six days of the oak pollen season (Table II). There was a consistent daily correlation between the results of the two methods, the number of oak pollens per cubic yard of air being approximately 1.3 times greater than the number of pollens collected per square centimeter of gravity slide; consequently the factor of 1.3 is recommended as an oak pollen conversion factor in the Columbus, Ohio, area when the standard sampler is used. Durham's calculated conversion factors for burr and shingle oak are 1.74 and 1.45 respectively. These conversion factors are remarkably close to the writer's experimentally determined conversion factor for oak pollen in the Columbus area. Since the pollen grains of all the oaks are very similar in size and configuration, this close agreement of the calculated and experimental conversion factors lends support to the accuracy of Durham's calculations for the determination of conversion factors for various important hay fever pollens by reference to their relative rates of fall as compared to that of short ragweed.

SUMMARY

1. A new volumetric method for determining the atmospheric concentration of pollens is reported.

2. Data from four standard gravity slide collectors, variously located within Columbus, Ohio, show that the atmospheric ragweed pollen concentration, as it occurs over most of the city is essentially uniform. Consequently, the data from a standard collector located well within the city can be used to represent the incidence, of this particular pollen, as it occurs over most of the city. Data from a single collector during the tree and grass pollen season cannot be so used since the atmospheric abundance of these grains varies greatly between the downtown and northern residential districts.

3. Volumetric tests were made during 29 consecutive days of the 1949 ragweed season. The volumetric incidence curve is included.

4. From simultaneous gravity slide and volumetric tests, made during 12 days of the ragweed pollen season, it was found that the number of giant ragweed pollen grains per cubic yard of air averaged 4.57 times greater than the number collected per square centimeter of a gravity slide exposed in a standard collector. Durham's calculated conversion factor for this pollen, when corrected for the smaller size of these grains in this area, is 4.96, and is considered to compare favorably with the writer's experimentally determined factor. It is therefore recommended that a conversion factor of 4.57 be used in this area during those years when giant ragweed pollen is predominate, and that Durham's conversion factor for short ragweed, corrected for size difference, be used when short-ragweed pollen is the dominant type.

5. The daily oak pollen concentrations during 1948 and 1949 are presented.

6. Simultaneous gravity slide and volumetric tests during nine days of the 1948 oak pollen season indicate that the average number of oak pollen per cubic yard of air is 1.3 times greater than the number of pollen per square centimeter of a slide exposed in a standard collector.

7. The close agreement between the writer's experimentally determined conversion factor for oak pollen in the Columbus, Ohio, area with Durham's calculated conversion factors for two species of oak lends support to the accuracy of Durham's calculations for the determination of conversion factors for various important hay fever pollens by reference to their relative rates of fall as compared to that of short ragweed.

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NOTES ON THE DRAGONFLIES (ODONATA) OF NORTHWESTERN OHIO

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INTRODUCTION

Up until about ten years ago, when the writer first began collecting Odonata in northwestern Ohio, relatively little work had been done on the order in this section of the state. This is an interesting section as certain northern and western species occur here which do not occur elsewhere in the state. The Odonata collected by the writer in northwestern Ohio through 1942 are summarized by Montgomery (1943); this paper supplements Montgomery's list, and is based on six additional seasons of collecting, 1943 through 1948. These records cover the following northwestern counties: Auglaize, Defiance, Fulton, Hancock, Henry, Mercer, Paulding, Putnam, Shelby, Van Wert and Williams.

Montgomery's paper (1943) brought the list of Odonata recorded from Ohio to 133 species; five additional species are recorded in this paper, bringing the list to 138. These five species are *Somatochlora ensigera*, *Macromia wabashensis*, *Gomphus* (*Stylurus*) *laurae*, *Coenagrion resolutum*, and *Gomphus externus*. Previously (Borror, 1937) there was some doubt as to the occurrence of *Aeshna clepsydra* in Ohio; the collection of 22 specimens of this species by the writer in Williams Co. definitely establishes this species as occurring in the state.

The writer is deeply indebted to Dr. B. Elwood Montgomery, of Purdue University, for making or checking the determinations of most of the species recorded in this paper; he is also indebted to Mrs. L. K. Gloyd for checking the determinations of *G.* (*S.*) *laurae*. The majority of the specimens collected by the writer are in the writer's collection, but some specimens have been given to the Ohio State Museum collection in Columbus, the Experiment Station at Wooster, the U. S. National Museum, and the private collections of Dr. B. E. Montgomery and Dr. D. J. Borror.

Most of the records in the list below are new county records. Williams Co., with 74 species of Odonata, ranks second in the state in number of species (Franklin Co. is first with 80 species), while Paulding Co., with 70 species, is third. A few sight records were made which would have represented new county records had the specimens been collected; these are *Nasiaeschna pentacantha* in Paulding Co., and N. *pentacantha*, *Libellula incesta*, *Epicordulia princeps*, *Trapezostigma carolina*, and *Pantala flavescens* in Williams Co. It seems very likely that with additional collecting Williams Co., the extreme northwestern county in Ohio, will equal or exceed every other Ohio county in the number of species of Odonata; it is conceivable that as many as 100 species may eventually be taken there.

The localities at which the collections recorded in this paper were made are as follows:

Auglaize Co.—The State Fish Hatchery, near St. Mary's.

Defiance Co.—Little (Krill's), Lehman's, and Ladd's Lakes; the Maumee and Auglaize Rivers; Lost, Lick, Bee Tree, and Eagle Creeks; and the Miami Extension Canal, southwest of Defiance, near the Paulding Co. line. Little Lake is a fairly good collecting area in some seasons.

Fulton Co.—Mill Creek, and Harrison Lake. Harrison Lake is a newly created lake, formed by damming Mill Creek.

Hancock Co.—Haley's Pond (Blanchard Twp.).

Henry Co.—The Maumee River and the Miami Extension Canal.

Mercer Co.—Chickasaw Creek, the Wabash River, and Grand Reservoir (also called Celina Reservoir or Lake St. Mary's).

Paulding Co.—The Maumee, Auglaize, and Little Auglaize Rivers; the Flatrock, Blue, Six Mile, and Marie DeLarme creeks; the south loop of Gordon Creek; Bailey's gravel pit (Paulding Twp.), Klinger's gravel pit (Jackson Twp.), and old tile pond in Benton Twp., and a pool formed by an artesian well in Brown Twp.; also various fields, woods, ditches, streams, etc. The Maumee River, above the Forder Bridge, has a rather surprising odonate population for a stream so heavily polluted with sewage.

Putnam Co.—A large abandoned tile pond at Miller City, and the railroad reservoir at Continental.

Shelby Co.—The south shore of Lake Laramie, and woodland pools nearby.

Van Wert Co.—An abandoned stone quarry at Willshire.

Williams Co.—St. Joseph's River, Fish, Bear, and Nettle Creeks, Mud and Nettle Lakes, two unnamed ponds, and two gravel pits. Mud Lake is the most interesting of the lakes in this county; it is said to have been heavily dynamited by railroad laborers a number of years ago for its fish, and the present owner insists that it now contains very few fish. Its bog meadow, with tamarack, poison sumac, shrubby cinquefoil, cranberry, several species of orchids, and fringed gentian, has a nice population of unusual Odonata, butterflies, and Orthoptera *Gomphus spicatus* fairly swarmed at this lake in June, 1948. Many afternoons were spent along Fish Creek east of Route 49, as well as at the St. Joseph's River near its confluence with the creek; the gomphine population there is excellent. Fish Creek is the outlet for Hamilton Lake (in Indiana).

On October 2, 1948, a special trip was made to Oxford, Ohio, to collect *Archilestes grandis* (Rambur). The weather was pleasantly cool. The creek just south of Miami University, where the collecting was done, was dry except for occasional shallow pools. The writer was there from 1:00 to 2:30 P. M., and collected six males and two females. All were easy to capture, and one pair in copulo was taken by hand. Some eighteen or twenty other individuals were seen. Some males had short abdomens. Pairs were in copulo among the short willows, well up from the water. No females were seen ovipositing, but Kennedy (in Needham and Heywood, 1929, p. 269) states that *A. californica* uses the stems of woody plants such as willows and alders for ovipositing; perhaps *A. grandis* may do the same. Only one male was seen hunting for prey. This species has been recorded from this locality by Williamson (1930), Cotterman (1930), and Montgomery (1943).

LIST OF SPECIES

The species in the following list are numbered according to Borror's list (1937), and the records are given by counties. Additional data are given for some species.

2. *Gomphoides obscura* (Rambur). Defiance, Paulding, Williams. This species is rather common along Fish Creek in Williams County and Lost Creek in Defiance County; it was also taken along the south loop of Gordon Creek and the ripples in the Maumee River one-half mile west of the Forder Bridge in Paulding County.

3. *Hagenius brevistylus* Selys. Paulding, Williams. This species seems to be uncommon. On August 1, 1946, at the St. Joseph's River in Williams County, I saw a *Hagenius* capture a *Calopteryx maculatum* and carry it to a barbed wire fence nearby where it seemed to roll the body of its prey into a ball. About five minutes later I tried to capture it but it boldly flew under the net and carried its prey to the upper branches of a tree where it was lost to view. At this time it had not removed the wings of the *Calopteryx*.

4. *Ophiogomphus rupinsulensis* (Walsh). Williams. Several specimens were taken along the St. Joseph's River.

7. *Gomphus* (*Stylurus*) *amnicola* Walsh. Paulding, Williams. Several were collected along Fish Creek and the St. Joseph's River in late August and early September. One Paulding County specimen taken. They were rather common at the ripples of the Maumee River west of the

Forder Bridge in Paulding County; a single male was secured on August 4, 1947. Four specimens were captured at the St. Joseph's River in Williams County: 1 ♀ 8/28/45, 1 ♂ 9/4/45, 1 ♀ 8/29/46, 1 ♀ 9/3/46.

9. *Gomphus exilis* Selys. Fulton, Williams. Several were collected along Nettle Creek in Williams County, where it was rather common. One specimen was taken at Mill Creek in Fulton County.

138. *Gomphus externus* Hagen. Paulding. This species is an addition to the Ohio list. Borror (1935) has shown that Kellicott's (1899) record of this species was really *Gomphus crassus*. Seven males were taken at the ripples of the Maumee River west of the Forder Bridge on August 3, 4, 10, and 14, 1947. Nearly all were taken on boulders near the middle of the stream, where the width is about 260 feet; they were quite wary and it was necessary to move slowly to secure them. One male was taken with prey, a Cabbage Butterfly (*Pieris rapae*). The weather was exceedingly hot, the days these specimens were collected.

10. *Gomphus fraternus* (Say). Defiance, Paulding, Williams. Common; I have more specimens of this species in my collection than of any other *Gomphus*.

11. *Gomphus furcifer* Hagen. Defiance. Collected at Little (Krill's) Lake; not nearly as common as *Gomphus spicatus*.

12. *Gomphus graslinellus* Walsh. Fulton, Mercer, Williams. Common at the gravel pits and creeks, but taken sparingly along the larger rivers.

136. *Gomphus* (*Stylurus*) *laurae* Williamson. Williams. An addition to the Ohio list. Previous captures have been recorded by Williamson (1932) for Indiana, Virginia, Georgia and South Carolina. This species was collected near the confluence of Fish Creek and the St. Joseph's River about one mile northeast of Edgerton, Ohio. Most specimens were swept down from the foliage of trees overhanging the river or were taken as they flew by me over the shallow water by dropping the net over them quickly. The following specimens were taken: 1 ♂ 8/28/45, 1 ♀ 9/21/45, 1 ♂ 8/1/46, 1 ♂ and 1 ♀ 9/3/46, 2 ♂ and 1 ♀ 9/5/46, 1 ♂ 9/8/46. No specimens were taken in 1947 or 1948 and it is believed that the colony may have been wiped out by too much collecting. They are readily distinguished in flight from *Gomphus spiniceps* by the brighter color of the yellow on the last abdominal segments.

14. *Gomphus lividus* Selys. Williams. Collected only at Nettle Creek near Nettle Lake. Several specimens were taken.

16. *Gomphus* (*Stylurus*) *plagiatus* Selys. Paulding, Williams. A single female was collected at Nettle Creek in Northwest Township, Williams County, on July 17, 1947. One male was captured at ripples in the Maumee River in Paulding County west of the Forder Bridge on August 5, 1947. This species had a very erratic flight on the Maumee, where its zigzag maneuvers distinguished it from the long straight sweeps of *Gomphus spiniceps*. Many hours were spent in securing these two males.

17. *Gomphus quadricolor* Walsh. Williams. Collected sparingly at Fish Creek.

18. *Gomphus spicatus* Hagen. Defiance, Williams. Common at Ladd's and Little lakes in Defiance County and at Mud Lake in Williams County.

19. *Gomphus* (*Stylurus*) *spiniceps* (Walsh). Paulding, Williams. Only one specimen was taken at the ripples on the Maumee River in Paulding County. Numerous specimens of this large trim species were taken from 1945 to 1948 at Fish Creek and the St. Joseph's River in Williams County. A few were taken in August, but the majority were taken in September. Some were swept down from the foliage of trees overhanging the river, but more were taken by dropping the net over them suddenly as they approached me in their low flight over the rippling water. Several were seen as they captured their prey and some were taken with prey, but by the time they were secured the prey was lost; often they plunged into the water after prey, and one was seen to plunge entirely under the surface. One habit repeatedly observed was that of dipping into the water two or three times in succession and then flying up to the higher branches of the trees. The females oviposited much like the other species of *Gomphus*. I have seen them ovipositing in early October and have taken this species later in the season than any other gomphine. Williamson's statement (1932), "A good series of *Stylurus spiniceps* has never been taken," will no longer apply as I have taken a series of more than 85 specimens and have at the present time 69 specimens in my collection. Some specimens have a reddish bloom on the thorax; this may have been caused by cyanide. Fresh specimens have a faint pinkish bloom on the

under side of the thorax but not on the sides or above. Most specimens appear to have changed color but little in drying.

20. *Gomphus vastus* Walsh. Defiance, Paulding. Common at the ripples on the Maumee River above the Forder Bridge.

21. *Gomphus ventricosus* Walsh. Defiance, Williams. Numerous specimens were collected along Fish Creek and the St. Joseph's River in 1946.

25. *Dromogomphus spoliatus* (Hagen). Henry. Kellicott's statement, "Common in northwestern Ohio along the Maumee River and its tributaries and the Ohio Canal" (1899, p. 73), still holds true in part. I have found it common along the Auglaize River but have failed to observe it along the St. Joseph's River. In August, 1945, I captured a male *Macromia taeniolata* a few seconds after it had been knocked into the water by one of these insects. It is easily taken at times and very wary at other times. It is a very interesting species. Many specimens were taken.

28. *Basiaeschna janata* (Say). Williams. A single specimen was taken near Mud Lake on May 5, 1948.

30. *Boyeria vinosa* (Say). Auglaize, Defiance, Paulding, Williams. I have spent afternoons in September along the St. Joseph's River at the mouth of Fish Creek when one or more of this species would be in sight almost constantly. It is fairly common along Lost Creek in Defiance County, and is uncommon or rare in Paulding County where only one specimen has yet been captured. On September 8, 1945, at Fish Creek I collected 3 males and let 5 escape in a period of 15 minutes (timed). The streams of Paulding County seem to be too muddy and sluggish for this species. I captured two specimens with their prey (*Hetaerina americana*) and saw them carry away this species on numerous occasions. One was once seen feeding on a *Calopteryx maculatum*.

31. *Anax junius* (Drury). Defiance, Fulton, Henry, Williams.

33. *Nasiaeschna pentacantha* (Rambur). Defiance. A male and female were collected along the Miami Extension Canal southwest of Defiance. Difficult to take. This species was seen (but not collected) in Paulding and Williams Counties.

34. *Epiaeschna heros* (Fabricius). Defiance, Williams. At various times in May and early June, females have been seen ovipositing in rotten logs and bits of wood lying in water in a swampy woods along the Miami Extension Canal in Defiance County. One was observed at different times to alight on a large rusty metal container and try to oviposit. One alighted on my wet boots and tried to oviposit. They were also seen ovipositing on the trunks of small trees well above the water line as well as in mud. Five were seen at one time, all ovipositing near each other on a small badly rotted log. This species was very common in 1943; it has not been so plentiful since. These giant darners were fairly common along a slough of Flatrock Creek in Paulding County in June, 1948. I captured only one, and couldn't help noticing how inconspicuous they were when they flew up from the ground, practically at my feet. One who was not interested in Odonata probably would not have noticed them.

35. *Aeshna clepsydra* Say. Williams. A total of 20 ♂ and 2 ♀ were taken at Mud Lake: 3 ♂ and 1 ♀ 8/22/48, 2 ♂ 8/24/48, 8 ♂ 9/3/48, 4 ♂ 9/16/48, 3 ♂ and 1 ♀ 10/1/48. This species was partial to a bed of yellow water lilies and pickerel weed on the east side of the lake. Both females were captured there, one while ovipositing and the other just after a male had seized her. The female taken on October 1 was very dark (almost entirely brown). The color pattern on the side of the thorax was faint but similar to that of all others collected. She was ovipositing by extending her abdomen into mud and water while perched on a fallen plant. Another female (not collected) was observed on an earlier date ovipositing in a small knob of wet mud projecting out of the water; there were no plants of any kind on the knob. The males have a faded blue appearance in flight, much lighter than *A. constricta* or *A. mutata*. One was seen about 10 feet up on a tree trunk, but none were flushed from weeds or shrubs as was the case with *A. mutata* in June.

36. *Aeshna constricta* Say. Defiance, Mercer, Williams. More than 70 specimens of this species were taken in 1943. Most of them were taken at a slough of Flatrock Creek in Benton Township, Paulding County; sweet flag (*Calamus*) was abundant there and the females oviposited in its tissues. The males seemed to be looking for females. The majority were taken in September. Some were taken on chilly days.

37. *Aeshna mutata* Hagen. Williams. Rather common at Mud Lake in June, 1948. A single male was taken on July 4; by that time they had nearly disappeared. The blue face and compound eyes add to the beauty of this species.

38. *Aeshna umbrosa* Walker. Auglaize, Defiance, Fulton, Paulding, Williams. Probably less common in Paulding County than any of the above named counties.

39. *Aeshna verticalis* Hagen. Mercer, Paulding, Williams. Not nearly as common as *A. constricta.*

44. *Macromia illinoiensis* Walsh. Paulding, Williams. Many specimens were taken at the ripples in the Maumee River above the Forder Bridge; the species was not observed in numbers elsewhere. I find this a difficult species to see in flight. Most specimens have been collected in the first half of August.

128. *Macromia pacifica* Hagen. Paulding. One female was taken along Flatrock Creek in Benton Township on August 14, 1943. The silky sheen of the alternating bands of golden yellow and rich brown on the abdomen make this a beautiful species in life.

45. *Macromia taeniolata* Rambur. Paulding. Kellicott's observation, "Common in the northwestern part of the state along the Maumee River" (1899, p. 87) still holds true. I have observed and collected it most commonly at favored places along the Auglaize River and its lagoons. Thus far I have not seen it along the St. Joseph's River. Its habit of remaining in trees on some days makes it appear scarce when the opposite is true. I have collected as many as 20 specimens in an afternoon. It is a large and beautiful insect that is not too easy to collect.

135. *Macromia wabashensis* Williamson. Defiance. This species is an addition to the Ohio list. It has previously been recorded only from Wells County, Indiana. A single male was taken June 17, 1944, at the Miami Extension Canal, southwest of Defiance near the Paulding County line. The costa of the wings is yellow to the tip and the wings are largely flavescent.

49. *Epicordulia princeps* (Hagen). Defiance, Paulding (not collected). Observed at Ladd's and Little lakes in Defiance County, and at Klinger's Gravel Pit in Paulding County. Four beautiful specimens were taken in one afternoon at Little Lake in 1947. In my opinion this species is one of our most beautiful insects.

50. *Tetragoneuria cynosura* (Say). Defiance, Paulding, Williams. I have not seen this species as abundant in Ohio as at some of the Indiana lakes, where it virtually swarms in some seasons.

134. *Somatochlora ensigera* Martin. Paulding. A new state record. On June 20, 1943, a female was taken along a dirt road about 40 rods from a ditch in Benton Township. All specimens since have been taken along ditches at some distance from woods. On July 9, 1948, 8 ♂ and 1 ♀ were taken from 5:00 to 6:00 P. M. along a ditch near my home. A female was taken from this ditch on August 16, 1947; she was easily taken by hand while she was hovering and ovipositing in about one-half inch of water. She was nearly concealed from above by grasses and sedges that arched over the narrow trench at the bottom of the ditch. I have found the female of *S. linearis* difficult to take with a large net while in the act of ovipositing; its erratic flight in deep shade contrasts sharply with the hovering flight of *S. ensigera* in sunlight.

133. *Somatochlora linearis* (Hagen). Defiance. Most of the 60 specimens at hand (57 ♂ and 3 ♀) were taken in Paulding County along little streams flowing through woods; these streams were well shaded and were dry except for occasional pools. By walking slowly in the bed of the stream and watching carefully, one can sweep some specimens from roots or dead branches overhanging the stream. The middle of August is an excellent time to collect them in this region. This species is probably more plentiful in Ohio than is generally believed.

54. *Perithemis tenera* (Say). Defiance, Putnam, Williams. On August 24, 1948, a pair was seen in copulo on a leaf of the yellow water lily at Nettle Lake in Williams County. Still in copulo, they flew down to the water where the male released the female but fluttered attentively near while she oviposited like a *Libellula:* after two or three minutes they coupled and flew up to the leaf of another lily. This procedure was repeated twice while I was about 10 feet away. Williamson states (1932, p. 36), "It remains for some sympathetic observer to record the sexual antics of *P. tenera*, the act of oviposition. . . . "

55. *Celithemis elisa* (Hagen). Defiance, Paulding, Putnam, Williams.

56. *Celithemis eponina* (Drury). Defiance, Henry, Paulding, Putnam, Williams.

57. *Celithemis monomelaena* Williamson. Williams. Two specimens were taken at Mud Lake, in 1947 and 1948.

60. *Ladona julia* (Uhler). Williams. A good series (58 specimens) was taken from May 23 to June 30, 1948, at Mud Lake. They were abundant and easily taken. The height of their abundance seemed to be about May 30. On June 30 only one was seen.

62. *Libellula* (*Holotania*) *cyanea* Fabricius. Defiance, Williams. Common at Little Lake in 1945; uncommon or rare since then. Common at Mud Lake in 1947 and 1948.

63. *Libellula* (*Holotania*) *incesta* Hagen. Defiance, Williams (seen, not collected). Common at Little Lake in 1945; uncommon since.

64. *Libellula* (*Holotania*) *luctuosa* Burmeister. Defiance, Putnam.

65. *Libellula* (*Plathemis*) *lydia* Drury. Hancock, Putnam.

66. *Libellula* (*Neotetrum*) *pulchella* Drury. Henry, Hancock, Paulding.

68. *Libellula* (*Eolibellula*) *semifasciata* Burmeister. Defiance, Van Wert, Williams.

69. *Libellula* (*Holotania*) *vibrans* Fabricius. Defiance, Paulding. This species was observed in numbers at woodland pools in Paulding County and at swampy woods beside the Miami Extension Canal in Defiance County in 1943; numerous beautiful specimens taken. It is easily taken on some days and very hard to secure at other times. Several females were noted ovipositing by dipping the tip of the abdomen in water in the shade while one or more males fluttered above. Only one specimen has been taken since 1943. I have yet to see this species at a lake; woodland pools and swampy places seem to be its habitat.

70. *Sympetrum ambiguum* (Rambur). Defiance, Henry, Mercer. Many specimens were taken of this green-faced species.

71. *Sympetrum corruptum* (Hagen). Paulding. This species, the largest of our Sympetrums, was taken at artificial ponds. Several were taken in late July and early August at a waste pool of the Paulding Sugar Company at Paulding. It was taken sparingly at a large abandoned tile pond at Miller City in Putnam County. It is far more wary than our other Sympetrums. Some specimens looked like *Pantala flavescens* while flying.

72. *Sympetrum obtrusum* (Hagen). Defiance, Henry, Mercer, Paulding.

73. *Sympetrum rubicundulum* (Say). Henry, Hancock, Van Wert.

74. *Sympetrum semicinctum* (Say). Defiance, Paulding. All specimens from Defiance County were taken at a slough of Lost Creek on the Bricker Stock Farm northeast of Hicksville. Several were taken in 1948 at a pool formed by an artesian well in Brown Township, Paulding County. This pool has already been ruined by drainage.

76. *Sympetrum vicinum* (Hagen). Defiance, Putnam, Williams.

77. *Leucorrhinia intacta* (Hagen). Defiance, Fulton, Hancock, Paulding, Williams.

78. *Pachydiplax longipennis* (Burmeister). Fulton, Hancock, Putnam, Williams.

79. *Erythemis simplicicollis* (Say). Defiance, Hancock, Paulding, Putnam.

80. *Pantala flavescens* (Fabricius). Paulding, Williams (seen, not collected). Difficult to capture.

81. *Pantala hymenaea* (Say). This species tires quickly in a stiff breeze. Many specimens were collected in Paulding County in 1943.

82. *Trapezostigma carolina* (Linnaeus). Williams (seen, not collected).

83. *Trapezostigma lacerata* (Hagen). Defiance, Hancock, Putnam, Williams. Common.

84. *Trapezostigma onusta* (Hagen). Paulding. Two males and one female were taken on July 23, 1948, at a waste pool of the Paulding Sugar Company at Paulding. The basal fourth of the hind wings was brown; the hamules of the males were much longer than the genital lobes. The vulvar lamina of the female was bilobed for the entire length. All were somewhat teneral; otherwise I probably would not have been able to capture them.

85. *Calopteryx aequabile* Say. Williams. Three males were captured and one teneral seen at Nettle Creek on June 8, 1948. A few days later another search was made for them at the same station but none were seen.

87. *Calopteryx maculatum* (Beauvais). Defiance, Fulton. This species is usually rather common along Fish Creek in Williams County in early September, after it has disappeared elsewhere in this area.

88. *Hetaerina americana* (Fabricius). Defiance, Fulton, Henry, Mercer, Williams.

89. *Hetaerina titia* (Drury). Williams. Common in September at Fish Creek. On September 8, 1945, a female was observed for perhaps thirty seconds while she crawled and oviposited on a board about two inches under water at Fish Creek. In September, 1946, a male and female in tandem alighted on a rotten stump in the St. Joseph's River near me. The female began backing down into the water, and when the tip of the abdomen of the male touched the water he released her; she then disappeared from sight. Several minutes later I rolled the stump over and found the female still ovipositing in the stump about four inches under water.

91. *Lestes congener* Hagen. Paulding, Williams. Fairly common in autumn.

92. *Lestes disjunctus* Selys. Several males were taken at a slough of Flatrock Creek in Benton Township, Paulding County, on April 21, 1946.

94. *Lestes forcipatus* Rambur. Defiance, Paulding, Williams.

95. *Lestes inaequalis* Walsh. Defiance, Williams. Taken in small numbers at Little Lake in Defiance County and at Mud Lake in Williams County.

96. *Lestes rectangularis* Say. Defiance, Hancock, Henry.

97. *Lestes dryas* Kirby. Defiance, Hancock, Shelby.

98. *Lestes unguiculatus* Hagen. Defiance, Henry, Mercer, Williams.

99. *Lestes vigilax* Hagen. Williams. Several specimens were taken at Mud Lake in 1948.

100. *Argia apicalis* (Say). Henry, Williams.

102. *Argia moesta* (Hagen). Fulton, Henry, Mercer, Paulding.

103. *Argia sedula* (Hagen). Auglaize, Defiance, Paulding, Van Wert, Williams. Taken in small numbers, usually but one specimen a day.

104. *Argia tibialis* (Rambur). Defiance, Fulton, Paulding, Van Wert.

105. *Argia violacea* (Hagen). Defiance, Fulton.

108. *Nehalennia irene* (Hagen). Paulding, Williams.

137. *Coenagrion resolutum* (Hagen). Paulding. A new state record. A single male was taken in Benton Township at a slough of Flatrock Creek on July 16, 1945.

109. *Chromagrion conditum* (Hagen). Fulton, Paulding, Williams.

110. *Enallagma antennatum* (Say). Fulton, Henry, Putnam, Van Wert, Williams.

111. *Enallagma aspersum* (Hagen). Defiance, Williams.

112. *Enallagma boreale* Selys. Defiance, Williams. Four males of this species were collected: 1 ♂ Miami Extension Canal (Defiance Co.), 6/19/46; 1 ♂ 5/28/48 and 2 ♂ 5/30/48, Mud Lake (Williams Co.).

129. *Enallagma basidens* Calvert. Defiance, Putnam, Van Wert, Williams. Well distributed over this area, especially at gravel pits.

114. *Enallagma civile* (Hagen). Auglaize, Henry, Mercer, Putnam, Williams.

117. *Enallagma ebrium* (Hagen). Defiance, Henry, Williams.

118. *Enallagma exsulans* (Hagen). Fulton, Henry, Mercer, Williams.

119. *Enallagma geminatum* Kellicott. Defiance, Williams.

120. *Enallagma hageni* (Walsh). Paulding, Williams.

121. *Enallagma signatum* (Hagen). Defiance, Mercer, Putnam.

122. *Enallagma traviatum* Selys. Defiance, Williams.

123. *Enallagma vesperum* Calvert. Defiance, Williams. Abundant at Little Lake, Defiance County, in late afternoons in the summer of 1945. Scarce at Mud Lake in Williams County, in 1948.

124. *Ischnura posita* (Hagen). Defiance, Putnam, Williams.

126. *Ischnura verticalis* (Say). Fulton, Hancock, Putnam, Williams.

127. *Anomalagrion hastatum* (Say). Paulding.

The collections of the writer in northwestern Ohio have extended the seasonal range of many species in the state. The new late dates are given below (the species are numbered as in the preceding list).

2. *Gomphoides obscura* (Rambur). Sept. 1, 1945.

3. *Hagenius brevistylus* Selys. Sept. 1, 1945.

7. *Gomphus (Stylurus) amnicola* Walsh. Sept. 3, 1946.

10. *Gomphus fraternus* (Say). Aug. 10, 1947.

11. *Gomphus furcifer* Hagen. July 8, 1945.

12. *Gomphus graslinellus* Walsh. Aug. 5, 1943.
16. *Gomphus* (*Stylurus*) *plagiatus* Selys. Aug. 5, 1947.
19. *Gomphus* (*Stylurus*) *spiniceps* (Walsh). Oct. 7, 1945.
21. *Gomphus ventricosus* Walsh. July 12, 1946.
25. *Dromogomphus spoliatus* (Hagen). Sept. 27, 1945.
30. *Boyeria vinosa* (Say). Oct. 1, 1944.
33. *Nasiaeschna pentacantha* (Rambur). July 8, 1943.
36. *Aeshna constricta* Say. Oct. 10, 1943.
44. *Macromia illinoiensis* Walsh. Sept. 4, 1945.
128. *Macromia pacifica* Hagen. Aug. 14, 1943.
45. *Macromia taeniolata* Rambur. Sept. 1, 1945.
133. *Somatochlora linearis* (Hagen). Aug. 24, 1945.
64. *Libellula* (*Holotania*) *luctuosa* Burmeister. Sept. 21, 1945.
65. *Libellula* (*Plathemis*) *lydia* Drury. Sept. 18, 1942.
66. *Libellula* (*Neotetrum*) *pulchella* Drury. Sept. 5, 1943.
68. *Libellula* (*Eolibellula*) *semifasciata* Burmeister. Aug. 9, 1943.
69. *Libellula* (*Holotania*) *vibrans* Fabricius. Sept. 10, 1943.
72. *Sympetrum obtrusum* (Hagen). Sept. 27, 1945.
73. *Sympetrum rubicundulum* (Say). Oct. 7, 1945.
76. *Sympetrum vicinum* (Hagen). Nov. 18, 1945.
87. *Calopteryx maculatum* (Beauvais). Sept. 21, 1945.
88. *Hetaerina americana* (Fabricius). Oct. 18, 1944.
89. *Hetaerina titia* (Drury). Oct. 1, 1944.
91. *Lestes congener* Hagen. Nov. 1, 1944.
94. *Lestes forcipatus* Rambur. Sept. 15, 1943.
96. *Lestes rectangularis* Say. Oct. 10, 1945.
98. *Lestes unguiculatus* Hagen. Sept. 26, 1948.
100. *Argia apicalis* (Say). Oct. 1, 1944.
102. *Argia moesta* (Hagen). Oct. 1, 1944.
104. *Argia tibialis* (Rambur). Sept. 27, 1945.
105. *Argia violacea* (Hagen). Sept. 21, 1945.
129. *Enallagma basidens* Calvert. Sept. 21, 1945.
127. *Anomalagrion hastatum* (Say). Sept. 3, 1944.

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DID YOU KNOW?

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PERMEABILITY—A PRIME FACTOR IN EXTRACTION OF CHLOROPLAST PIGMENTS

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Yellow Springs, Ohio

The extraction of chloroplast pigment from dried nettle leaves is accomplished best in 80–90% aqueous acetone, in 90% aqueous ethanol and in absolute methanol (Willstätter and Stoll, 1913). Just why 80–90% aqueous acetone is better than anhydrous acetone, why 90% aqueous ethanol is better than absolute ethanol, and why absolute methanol is better than any of its aqueous dilutions has never been satisfactorily explained. Willstätter and Stoll (1913, p. 57) explained it on the basis that "water added to the organic solvents dissolves mineral salts, as for example, potassium nitrate, from the leaf substance," and that "salt solution that is formed changes the colloidal state of the chlorophyll in the chloroplasts and makes it easily soluble."

MATERIALS AND METHODS

To study the permeability of plant tissues to various organic solvents, seeds of sweet corn, soybean, and garden pea were used. The sweet corn was Burpee's Golden Bantam; the soybeans were of the Lincoln variety locally acquired; and the garden pea seeds were Burpee's Blue Bantam (wrinkled). The seeds were soaked in organic solvents at room temperature (25–30° C.), and weighings of the superficially dried seeds were taken at the end of 1 day, 4 days, and 7 days. The organic solvents were methanol, ethanol, and acetone. Methanol was dehydrated with magnesium turnings which forms magnesium methoxide, then refluxed and distilled. Ethanol was dried over Drierite and then with metallic sodium which forms sodium ethoxide; then refluxed and distilled. Acetone was dried merely over Drierite, then refluxed and distilled. The aqueous dilutions of methanol, ethanol, and acetone were made on the basis of volume.

Changes in the lengths of soybean seeds soaking in absolute, 95%, 90%, and 85% methanol were determined by use of a vernier calipers. Specific gravity for some of the solutions was determined by use of a specific gravity bottle.

A Klett Biocolorimeter was used to determine the relative amounts of chloroplast pigments extractable by acetone-water solvent to which $NaNO_3$ and cane sugar, respectively, had been added as compared to the amounts of chlorophyll pigments extractable by acetone-water solvent alone. The amount of pigments extractable by 85% acetone was used as the standard for comparison. It was given an arbitrary value of 100 and all the others were evaluated comparatively by colorimetric measurements.

EXPERIMENTAL RESULTS

Seeds of sweet corn, soybean and wrinkled garden pea soaked in absolute methanol, absolute ethanol, and anhydrous acetone showed a remarkably greater imbibition of absolute methanol during the first day than of absolute ethanol or of anhydrous acetone (Tables I and III). To be specific, soybean seeds absorbed or imbibed absolute methanol equal to 7.7% of their dry weight during the first day, whereas they imbibed absolute ethanol equal to only 1.6% of their dry weight in the same period of time, and anhydrous acetone equal to only 0.1% of their dry weight. This difference is more pronounced at the end of 4 days and at the end of 7 days. The soybean seeds in absolute methanol also showed a distinct increase in

TABLE I

INCREASE IN WEIGHT OF 100 SOYBEAN SEEDS SOAKED IN VARIOUS ORGANIC SOLVENTS

Solvent in Days	Weights in Grams	Per Cent Increase
Absolute methanol (100%)		
0	12.95	....
1	13.95	7.7
4	14.30	10.4
7	14.59	12.7
Absolute ethanol (100%)		
0	14.94	....
1	15.50	1.6
4	15.65	2.6
7	15.77	3.4
Anhydrous acetone (100%)		
0	13.17	....
1	13.18	0.1
4	13.31	1.1
7	13.47	2.3

TABLE II

INCREASE IN LENGTH OF SOYBEAN SEEDS SOAKED IN WATER-FREE SOLVENTS. DATA ARE AVERAGES OF 10 SEEDS. ABSOLUTE INITIAL AVERAGE LENGTHS ARE GIVEN IN PARENTHESES

Days Soaked	Absolute Methanol (.725 cm.)	Absolute Ethanol (.742 cm.)	Anhydrous Acetone (.718 cm.)
1	.036 cm.	.010 cm.	.003 cm.
4	.061 cm.	.020 cm.	.020 cm.
7	.....	.031 cm.	.031 cm.
14	.091 cm.	.039 cm.	.041 cm.

TABLE III

INCREASE IN WEIGHT OF 50 SEEDS OF WRINKLED PEA AND OF 50 SEEDS OF SWEET CORN SOAKED IN VARIOUS ORGANIC SOLVENTS

Solvent in Days	Wrinkled Pea		Sweet Corn	
	Weight in Grams	Per Cent Increase	Weight in Grams	Per Cent Increase
Absolute methanol (100%)				
0	14.30	....	12.61	....
1	15.76	10.2	13.72	8.8
4	16.73	17.0	14.24	12.9
7	17.38	21.5	14.55	15.4
Absolute ethanol (100%)				
0	14.69	....	13.92	....
1	14.89	1.4	14.16	1.7
4	15.42	5.0	14.18	1.9
7	15.83	7.8	14.25	2.4
Anhydrous acetone (100%)				
0	13.03	....	13.46	....
1	13.03	0	13.61	1.1
4	13.00	0	13.59	1.0
7	13.00	0	13.60	1.0

length in contrast to very little change in the length of seeds soaked in absolute ethanol and anhydrous acetone (Table II).

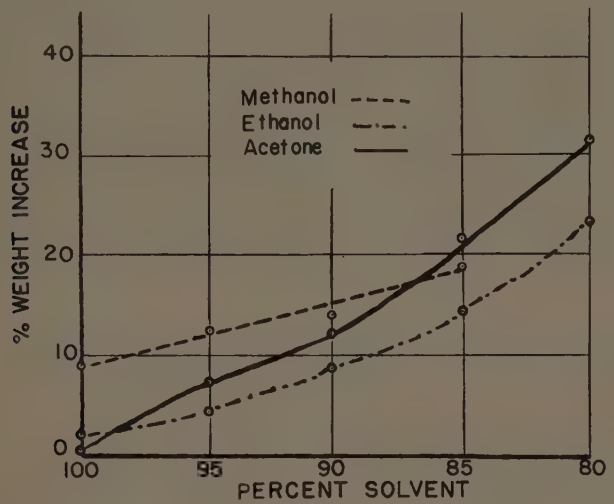

FIG. 1. Per cent increase in weight of sweet corn seeds soaked in various aqueous dilutions of methanol, ethanol, and acetone for one day.

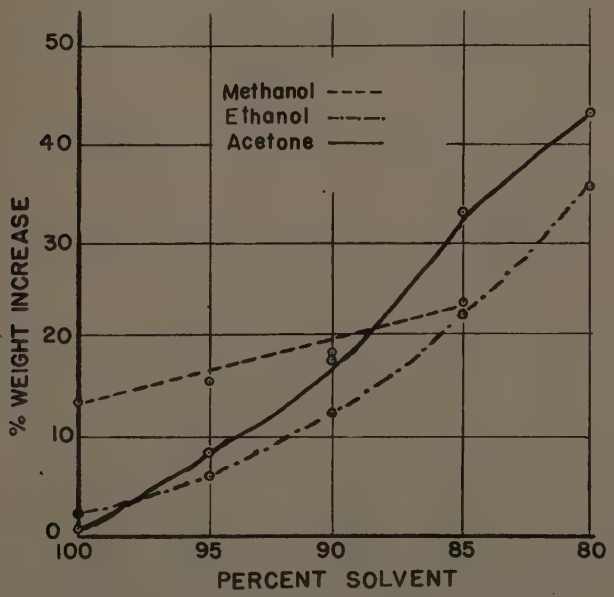

FIG. 2. Per cent increase in weight of sweet corn seeds soaked in various aqueous dilutions of methanol, ethanol, and acetone for four days.

Seeds in absolute methanol get to be quite soft and can be sectioned very easily with a razor blade. This is not true for seeds soaked in absolute ethanol or in anhydrous acetone which only permeates slightly and produces little change in the original hardness of the seeds. The data for sweet corn seeds and for wrinkled pea seeds (Table III) are even more diverse in the differences. Permeability in various aqueous dilutions of methanol, ethanol, and acetone can best be described by the graphic illustrations of Figures 1–3. The points for methanol form an approximate straight line which has about the same slope in the 1-day, 4-day, and 7-day periods. The points on the graph for ethanol and for acetone form curves which have distinctly greater slopes than the line for methanol. Of the curves for ethanol and for acetone, the curve for acetone has the greater slope, and the slope for the 4 days is greater than for one day and greater for 7 days than for 4 days. This means that dilutions of these three organic solvents with water

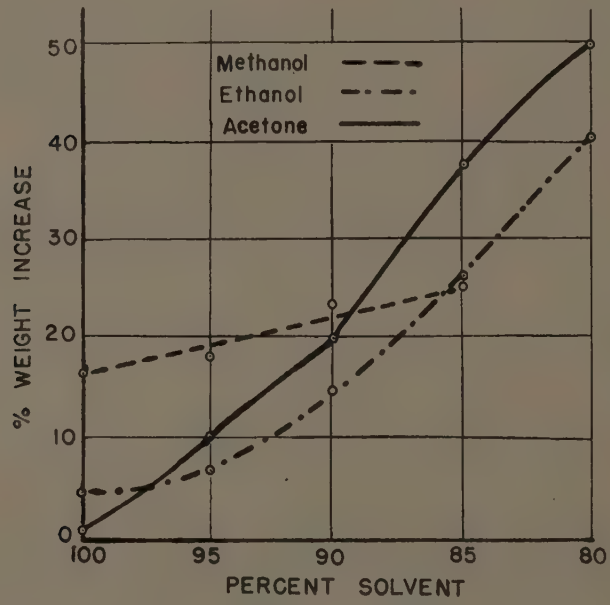

FIG. 3. Per cent increase in weight of sweet corn seeds soaked in various aqueous dilutions of methanol, ethanol, and acetone for seven days.

produce the greatest change in imbibition with acetone, and least with methanol. The result is that all of these lines intersect. Whereas 100% methanol is imbibed far more abundantly than either 100% ethanol or 100% acetone, 85% acetone is imbibed more than either 85% ethanol or 85% methanol. All of the graphs show this tendency for greater increase in absorption of acetone with greater aqueous dilutions and for a rather uniform increase in absorption of methanol with greater aqueous dilutions. Ethanol is intermediate between methanol and acetone.

The specific gravity determinations presented in Table IV show very little difference in values at the start as compared to the end of an imbibitional period. This seems to indicate that there is very little or no differential or preferential

absorption of either the organic solvent or the water which dilutes the organic solvent.

Sugar and Salt Effect.—That penetrability of solvent is a prime factor in the extraction of chloroplast pigments is further substantiated by the effect of salts and sugars. Sodium nitrate decisively increases the amount of chloroplast pigments extracted from dry nettle leaf powder in one hour by 80% acetone, and cane sugar decreases the amount of chloroplast pigments extractable in one hour (Table V). Quantities used in each case were 1 g. of dried nettle leaves, 20 ml. of acetone solvent, 1 g. $NaNO_3$ and 5 g. of cane sugar. Values are those obtained by comparing the extract colorimetrically with the extract in 85% acetone which was used as the standard and arbitrarily given the value of 100.

A corresponding effect is registered by the sodium nitrate and the cane sugar on the initial rate at which seeds imbibe 80% acetone. The data are given in Table VI.

TABLE IV

SPECIFIC GRAVITY CHANGES IN SOLVENTS DURING A 21-DAY SOAKING PROCESS

SOLVENT	SEEDS	SPECIFIC GRAVITY	
		Beginning	End
Acetone, 100%	Wrinkled pea	.790	.789
95%	" "	.807	.807
80%	" "	.826	.822
100%	Sweet corn	.790	.792
95%	" "	.807	.811
90%	" "	.826	.827
80%	" "	.862	.868
Methanol, 100%	Sweet corn	.793	.800
95%	" "	.811	.819
90%	" "	.827	.829
85%	" "	.843	.838
Ethanol, 100%	Sweet corn	.795	.801
95%	" "	.809	.811
90%	" "	.827	.829

Sodium nitrate and cane sugar have another effect, also. This effect is on the solubility of chloroplast pigments. The effect is, however, slight (about 6–9%) and in the direction of decreased solubility. The greatest influence of the salt and the sugar on extractability of chloroplast pigments must be accredited to their effect on the permeability of the plant material to the solvent.

DISCUSSION

The extraction curves of Willstätter (1915) as presented in Figure 4 can be explained by a joint consideration of chloroplast pigment solubility and of the relative permeability of plant tissues to these solvents and their aqueous dilutions. Chlorophyll pigments are always more soluble in water-free fat solvents and become less and less soluble as the water content increases. Although chloroplast pigments are more soluble in anhydrous acetone than in 80% acetone, the dominant

influence in extraction is the very low permeability of dry leaf powder to anhydrous acetone and its extremely high permeability to acetone containing 20% water.

Dry plant tissues are extremely permeable to methanol. The permeability to absolute methanol is high, and the permeability increases only slowly to mixtures of water and methanol. Chloroplast pigment solubility in methanol decreases rather rapidly as the water content increases. With acetone the chloroplast pigment solubility does not drop nearly as rapidly with an increase in water content (Eyster, unpublished data). Since extraction of chloroplast pigments seems to be due to a combined joint influence of solubility and tissue permeability, this perhaps is adequate to account for the fact that extraction of chloroplast pigments is always greatest in absolute methanol and decreases in dilutions of methanol with water.

TABLE V

EXTRACTABILITY OF CHLOROPLAST PIGMENTS FROM DRIED NETTLE LEAVES IN ONE HOUR AT ROOM TEMPERATURE AS AFFECTED BY $NaNO_3$ AND CANE SUGAR. THE DATA ARE ONLY COMPARATIVE VALUES AND WERE OBTAINED BY COLORIMETRICALLY COMPARING THE FILTERED SOLUTIONS WITH THE 85% ACETONE FILTRATE VALUED ARBITRARILY AT 100

Solvent Per Cent	Acetone	Acetone + $NaNO_3$	Acetone + Cane Sugar
100%	24	21	17
95%	67	83	55
90%	92	113	82
85%	100	132	86
80%	94	134	63

TABLE VI

INFLUENCE OF $NaNO_3$ AND SUCROSE ON THE INCREASE IN WEIGHT OF 50 WRINKLED PEA SEEDS SOAKED IN 80% ACETONE

SOLUTION (100 ml.)	WEIGHT IN GRAMS AND PER CENT INCREASE		
	At Start	One-Half Day	One Day
80% acetone	12.62	13.08 (3.7)	14.09 (11.7)
80% acetone + .1 M $NaNO_3$	13.05	14.44 (10.7)	15.25 (16.9)
80% acetone + 10 g. cane sugar	13.01	13.31 (2.3)	13.92 (7.0)

SUMMARY

The data obtained by Willstätter and Stoll (1913) on the amount of chloroplast pigments extractable from dried nettle leaf powder by methanol, ethanol, acetone and their aqueous dilutions seem to be a net result of the permeability of the plant material to the solvents and of the solubility of the chloroplast pigments in the respective solvents. Seeds of sweet corn, soybean, and wrinkled pea were soaked in 100%, 95%, 90%, 85% methanol, in 100%, 95%, 90%, 85%, 80% ethanol, and in 100%, 95%, 90%, 85%, 80% acetone. Weighings were made immediately before soaking and at the end of 1, 4, and 7 days. Length measurements were

also obtained from soybean seeds. The weight increases during the first day for wrinkled pea seeds were 10.2% in absolute methanol, 1.4% in absolute ethanol, and 0% in anhydrous acetone. With aqueous dilutions and also for longer periods of time the increases were greater. The data for soybean seeds and for sweet corn seeds were the same comparatively as for wrinkled pea seeds.

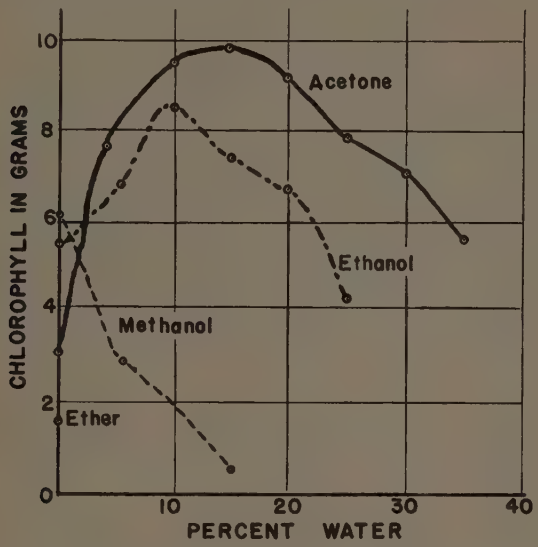

FIG. 4. Extractability of chlorophyll from dried and pulverized leaves by various organic solvents. After Willstätter (1915, p. 335).

Sodium nitrate decisively increases the amount of chloroplast pigments extracted from dry nettle leaf powder in one hour by 80% acetone, and cane sugar decreases the amount. A corresponding effect is registered by the sodium nitrate and the cane sugar on the initial rate at which seeds imbibe 80% acetone.

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THIONYLDIACETIC ACID—CORRECTION

In the July, 1949, issue of The Ohio Journal of Science, Mr. Dodson and I were the authors of a paper, titled "Thionyldiacetic Acid." In this paper we stated that Larsson had reported, in 1940, that he had obtained thionyldiacetic acid with a melting point of 109° C. (Svensk. Kem. Tids., 52: 9–15).

A personal communication from Professor Larsson points out that we were in error and that the melting point of 109° C. was that of oxythiodiacetic acid and not thionyldiacetic acid. We acknowledge the error which, though unintentional, is to be regretted.—H. G. ODDY.

A NEW SPECIES OF DIKRANEURA FROM WITCH-HAZEL

(HOMOPTERA—CICADELLIDAE)

DWIGHT M. DELONG,
Ohio State University, Columbus, Ohio
AND
HERBERT H. ROSS,
Illinois Natural History Survey, Urbana, Illinois

While collecting in a wooded area in the Great Smoky Mountains National Park in Tennessee, an interesting new species of *Dikraneura* was collected from witchhazel, *Hamamelis virginiana*. To our knowledge, this is the first time that a cicadelline leafhopper has been reported from this host, which thus adds a new plant genus and family to the biological orbit of the Cicadellinae.

This new species has posed a taxonomic problem in that it agrees very well with venational and other general characteristics of the genus *Dikraneura*, but the male

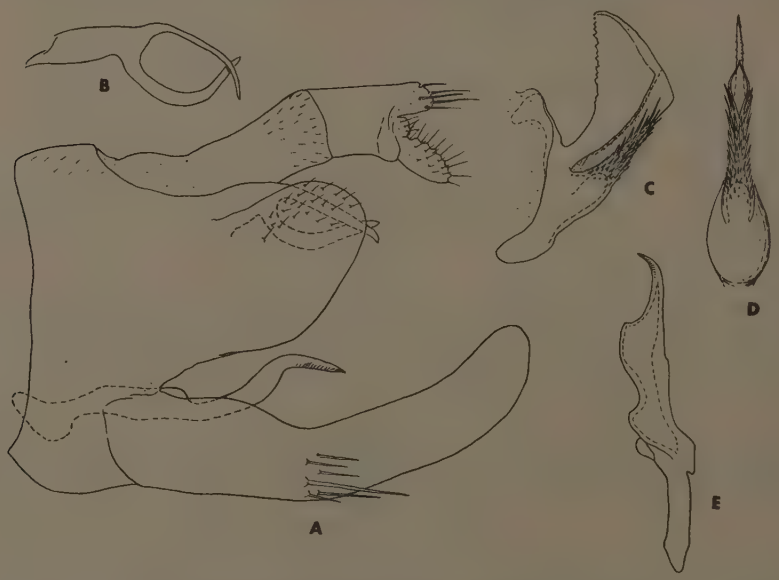

FIG. 1. *Dikraneura hamar*, male genitalia. A, lateral aspect of external parts; B, ventro-lateral aspect of pygofer hook; C, aedeagus, lateral aspect; D, aedeagus, posterio-ventral aspect; E, style, ventral aspect.

genitalia are extremely different from any described North American species, and from any European species illustrated by Ribault. Especially peculiar are the forked and clasplike pygofer hook and the very peculiar aedeagus, Fig. 1. At first we considered erecting a new subgenus to receive this species, but believe that for the present it would be more satisfactory to simply indicate this as a distinctive species group.

Dikraneura hamar n. sp.

A pale, yellowish, blunt-headed species resembling *Forcipata* in general appearance. Length 3.5 mm.

The vertex is produced, tapered, and blunt at apex. In general appearance the insect is narrow with the wings decidedly longer than the abdomen. The vertex, pronotum and scutellum are white tinted with yellow. The elytra are lemon-yellow subhyaline. The wings are white subhyaline.

The female seventh sternite is roundedly produced.

The male plates are long and narrow. The style in ventral view is concavely narrowed on the outer margin at the apex so as to form a narrow, sharp-pointed spine which curves outward at the apex. The aedeagus in posterio-ventral view appears enlarged at base and narrowed, tapering to a slender apex. In lateral view it appears broad with a basal pubescent ventral portion and a broadened, blade-like apical portion serrate on the anterio-dorsal margin. The pygofer bears a dorso-caudal hook on each side which is divided into two long terminal spines which are widely separated at base and usually converge and overlap at apex.

Holotype, male.—Chimneys Campground, Great Smoky Mountains National Park, Tennessee, September 1, 1948, from *Hamamelis virginiana*, Ross and Stannard. *Allotype, female*, and 32 *paratypes*—Same data. Holotype, allotype, and male and female paratypes in the collection of the Illinois Natural History Survey; male and female paratypes in the DeLong Collection at The Ohio State University.

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OHIO'S STATUS AS A GAME AND FUR PRODUCING STATE

DANIEL L. LEEDY,[1]
U. S. Fish and Wildlife Service,
Washington, D. C.

That Ohio is a great agricultural and industrial State and also ranks high in the value of minerals produced, particularly in coal, clay products, limestone, salt, gypsum, sand and gravel, are well known facts. That Ohio ranks high as a game and fur producing State, is known by relatively few people, even within the State. Thinking that some information on game and fur production would be of interest to the readers of the Ohio Journal of Science, the present article was prepared.

HUNTING PRESSURE IN OHIO

Ohio has an area of approximately 41,000 square miles and ranks 35th among the states in size. Nearly seven and one-half million people live within the State and, of these residents, about one in seven hunts or fishes or does both (Leedy and Dambach, 1948).

In a detailed study of game and wild fur production and utilization throughout the United States, Miller and Powell (1942) calculated that there were only 51 acres of potential huntable area per Ohio hunting license holder in 1935. In these calculations approximately 19.5 percent reduction in total land area was allowed for urban areas, highways, railroad rights-of-way, farmsteads, state game refuges and Army reservations on which public hunting was prohibited by law. No allowance was made for lands not available to hunters because they were posted by private landowners nor were the hunters, who hunted legally or illegally without licenses, included. It was pointed out that, of the estimated 20,996,911 acres of potential huntable land, 90.6 percent was privately owned and that a like percentage of this land was devoted to agriculture.

As one drives through the rich, agricultural area of western Ohio during March or early April he finds that more than one-third of the area is practically devoid of cover and includes plowed ground, soy bean stubble left after the beans have been combined and corn which has been cut and removed from the fields. In addition, many of the pastures and pastured woodlots provide but a minimum of cover.

The lush cover, available for farm game in the summer, has been reduced by the harvesting of hay and grains, further reduced by the clipping of grain stubble, fall and spring plowing, by winter winds, rain and snow and by the mowing and burning of ditch banks and fence rows until by April, with so little cover remaining, one wonders how game can survive in any considerable numbers at all.

It is likely, therefore, that the areas hunted were subjected to a hunting pressure considerably in excess of one hunter per 51 huntable acres in 1935 when the average ratio for the United States was estimated by Miller and Powell (1942) to be one hunter per 277 acres. At that time (1935) only New Jersey, Pennsylvania and New York, with hunter-acre ratios of 1 : 34, 1 : 39 and 1 : 47 exceeded Ohio in hunting pressures. In more recent years Dambach (1948) calculated a ratio of hunting licenses to huntable acres in Ohio of 1 : 30. If non-licensed hunters had been included, the ratio would have been increased still more.

[1]Most of the data upon which this paper is based were collected while the writer was Leader, The Ohio Wildlife Research Unit, Ohio State University, Columbus 10, Ohio: The Ohio Division of Conservation, The Ohio State University, The U. S. Fish and Wildlife Service and The Wildlife Management Institute cooperating.

OHIO HUNTER PREFERENCES AND HUNTING PRESSURE ACCORDING TO SPECIES

Following the 1946 and the 1947 hunting seasons the Ohio Division of Conservation and Natural Resources and the Ohio Wildlift Research Unit contacted, through questionnaires, samples of Ohio hunters in order to learn more about hunter preferences, wildlife economics and the game kill (Leedy, 1947, 1948a). These surveys showed that, in 1946, for every 100 hunters who indicated a preference for hunting pheasants, 58 preferred rabbit hunting, 21 preferred gray squirrels, 14 preferred raccoons and 11 preferred fox squirrels; and that, in 1947, regardless of preferences, 81 percent of the hunters hunted cottontails, 70 percent hunted pheasants, 48 percent hunted fox squirrels, 31 percent hunted gray squirrels and 12 percent hunted raccoons.

It is probable that hunter preferences for certain species are determined largely by the abundance and distribution of the game species and the ease with which they may be hunted. In spite of the fact that pheasants are not as abundant or as widespread in Ohio as rabbits, however, these exotic birds are a preferred game species and thousands of hunters travel to favorite bird counties in the northwestern part of the State to hunt them. On the basis of questionnaires returned by Ohio hunters following the 1947 season, approximately 16 percent of the license holders hunt or trap fur-bearing animals. The raccoon is the most popular species for the night hunters and muskrats provide most of the trapping. The number of Ohio hunters engaging in deer hunting within the State more than doubled from 1947 to 1948. During the latter year slightly less than 23,000 deer-hunting permits were issued (Chapman, 1949a). The number of Ohio grouse hunters is also increasing.

Having seen something of the hunting pressure in Ohio, the preferences of hunters for various species and the scarcity of cover, let us see how Ohio game and fur production compares with that of other States.

GAME AND FUR PRODUCTION IN OHIO AND OTHER STATES

A comparison of the numbers of game and fur animals taken in the various states can be made only with the appreciation that the kill data, if available at all, vary in completeness and accuracy from state to state and from species to species. Most state-wide kill figures are based upon questionnaires returned by samples of hunters contacted by game departments or upon the estimates of game department field men. The take of fur is often based upon reports of licensed fur buyers and may not represent the total harvest.

Considerable progress has been made in wildlife bookkeeping during the last decade through the cooperation of hunters and State and Federal agencies, especially with respect to the take of big game, waterfowl and furbearers. There is still much room for improvement, however, particularly concerning the kill of small game.

In September, 1948, a questionnaire and an explanatory letter were sent to each of the 48 State game departments in an attempt to obtain some information as to the kill of various game species, the number of people engaged in big game hunting as compared with small game hunting and other items of interest. The response of the State game officials in filling out and returning the questionnaires was excellent and the writer expresses his thanks for their cooperation. Much of the information, thus obtained, was summarized for presentation at the 14th North American Wildlife Conference (Leedy, 1949).

The remaining data presented here on the game kill by states are necessarily incomplete and must be considered for what they are—the best estimates available. It should also be remembered that the take of game and fur-bearing animals is not a true index of actual populations. Weather conditions, the number of hunters and trappers per unit of area, hunting regulations and other factors affect the relative percentage of a game population that is harvested by hunters.

TABLE I

STATISTICS, BY STATES, OF HUNTABLE AREAS, LICENSE SALES AND TAKE OF SELECTED GAME SPECIES.

States	Estimated Potential Huntable Areas in Acres[1]	Resident and Non-Resident Hunting Licenses Sold during the Fiscal Year Ending June 30, 1947[2]	Estimated Kill of Selected Species during the 1946 Season			
			Cotton-tail Rabbit	Fox Squirrel	Gray Squirrel	Ring-necked Pheasant
Alabama	29,359,934	203,097	500,000	3,000	120,000	.....
Arizona	48,119,127	49,673	.....	.....	.....	.....
Arkansas	30,029,210	193,196	.....	.....	.....	.....
California	89,968,393	483,176	.....	.....	.....	.....
Colorado	60,150,185	414,274	271,803	.....	.....	256,550
Connecticut	2,395,648	49,061	.....	.....	.....	.....
Delaware	1,039,046	21,408	59,843	.....	23,777	1,134
Florida	29,841,801	101,411	No seas'n	52,215	469,938	.....
Georgia	33,806,376	142,253	159,960	.....	.....	.....
Idaho	48,196,411	166,357	6,000	.....	.....	400,000
Illinois	30,617,802	426,270	.....	.....	.....	.....
Indiana	18,963,858	369,125	3,600,000	1,775,000	450,000	70,000
Iowa	30,808,824	294,580	1,500,000	300,000	100,000	500,000
Kansas	43,381,708	176,538	.....	.....	.....	.....
Kentucky	20,815,219	181,670	1,470,656	.....	.....	.....
Louisiana	26,388,909	170,396	.....	.....	.....	.....
Maine	17,799,593	133,321	.....	.....	16,000	12,000
Maryland	5,338,309	118,566	.....	.....	.....	1,125
Massachusetts	3,997,935	135,788	73,459	.....	25,277	26,198
Michigan	32,394,698	1,046,839	1,306,973	786,002	77,731	904,367
Minnesota	43,330,430	495,370	186,055	92,789	231,672	801,372
Missouri	38,409,640	332,480	5,000,000	1,203,000	699,000	.....
Mississippi	25,989,720	183,279	298,000	86,000	693,000	.....
Montana	81,503,329	149,119	.....	.....	.....	.....
Nebraska	45,753,279	220,688	500,000	200,000	.....	2,000,000
Nevada	62,314,858	25,738	.....	.....	.....	.....
New Hampshire	5,341,695	109,175	17,354	.....	25,806	8,827
New Jersey	3,920,131	183,107	794,136	.....	152,624	211,460
New Mexico	68,550,697	53,041	Not classed as game	.....	.....	4,000
New York	26,527,851	826,774	304,524	.....	144,673	71,258
North Carolina	26,581,678	207,904	1,513,385	1,000	2,000,000	.....
North Dakota	39,193,662	70,036	.....	.....	.....	800,000
Ohio	20,996,911	702,510	4,606,000	1,505,000	994,000	868,000
Oklahoma	36,499,250	165,431	Non-game	500,000	100,000	.....
Oregon	54,524,362	199,020	5,000	.....	2,000	300,000
Pennsylvania	24,109,118	843,040	1,524,798	.....	.....	213,384
Rhode Island	517,377	13,516	.....	.....	.....	.....
South Carolina	17,261,083	171,458	.....	.....	.....	.....
South Dakota	41,408,999	210,978	.....	.....	.....	3,550,132
Tennessee	21,671,088	246,824	.....	.....	.....	.....
Texas	155,061,620	234,720	Non-game	.....	.....	.....
Utah	47,543,363	108,041	.....	.....	.....	200,000
Vermont	5,258,292	72,248	.....	.....	.....	.....
Virginia	22,914,408	285,380	130,000	.....	150,000	.....
Washington	35,882,835	381,174	.....	.....	.....	217,000
West Virginia	13,823,713	264,683	725,000	285,000	1,625,000	.....
Wisconsin	30,469,631	378,941	755,200	375,546	638,474	437,428
Wyoming	54,406,415	55,089	Non-game	.....	.....	65,000

[1]After Miller and Powell (1942).

[2]Taken from Fish and Wildlife Service News Release dated February 8, 1948, based on data compiled by the Branch of Federal Aid in Wildlife Restoration.

In analyzing the questionnaires returned by 39 State game departments, it was evident that the cottontail rabbit, ring-necked pheasant, gray squirrel and fox squirrel furnished hunting for a high percentage of the country's nimrods. Considered collectively, ducks also provide much hunting, as do the bobwhite quail and the white-tailed deer (Leedy, 1949).

How Ohio ranked in the harvest of the first four species in 1946 is indicated in Table I. These and other species will be considered as follows:

Cottontail rabbit.—Ohio had a calculated kill of 4,606,000 rabbits in 1946, ranking a close second to Missouri, among 24 states reporting. Following Ohio were Indiana, Pennsylvania, North Carolina, Iowa, Kentucky and Michigan.

Fox squirrel.—In the reported take of fox squirrels by 14 states, Indiana ranked first with 1,775,000 followed by Ohio with 1,505,000, Missouri with 1,203,000 and Michigan with 786,000. In each of the other states reporting, less than 500,000 fox squirrels were taken by hunters.

Gray squirrel.—Among 21 states reporting the kill of gray squirrels, Ohio ranked third with 994,000 estimated to have been taken, following North Carolina with 2,000,000 and West Virginia with 1,625,000.

Ring-necked pheasant.—South Dakota, with a reported hunter take of 3,550,132 pheasants and Nebraska, with an estimated kill of 2,000,000 pheasants, far out-ranked any of the other 22 states reporting. Following Nebraska were Michigan with a reported kill of 904,367, Ohio with 868,000, and North Dakota with 800,000.

Waterfowl.—Ohio is not a leading state in the production or kill of waterfowl. For the fiscal year ending June 30, 1947, it ranked 24th among the states in the number of Federal duck stamps purchased, with 37,105 out of a total of more than 2,000,000 issued. Of the 26,000,000 ducks estimated to have been bagged by hunters in the United States in 1946, relatively few were killed in Ohio. Only 409 out of 8,449 Ohio hunters, who returned questionnaires following the 1946 season, had bagged any ducks (Leedy, 1947).

Bob-white quail.—There has been no open season on quail in Ohio since 1913. Quail population trends have apparently fluctuated in about the same manner as they have in Indiana where hunting is permitted. On a nation-wide basis, the harvest of quail probably exceeds that of the ring-necked pheasant. In northern Ohio, the bobwhite is approaching the northern limits of its range where it is subject to sharp population declines resulting from severe winter weather and other factors.

White-tailed deer.—This animal probably ranks within the first ten game species in providing sport to hunters in the United States. According to Chapman (1939) white-tailed deer nearly, if not completely, disappeared from Ohio about 1904 due to persecution and habitat depletion. Through the introduction of deer at the Roosevelt Game Preserve in southeastern Ohio, 1922 to 1930, and the spread of deer into northeastern Ohio from Pennsylvania, the Ohio deer herd recently has increased rapidly in the areas reverting to brush and forest cover. Chapman (1949a) estimated that approximately 1,200 deer were taken in northeastern Ohio in 1947 and nearly 3,000 in 1948. Compilations made by the U. S. Fish and Wildlife Service (1948) of big game populations in 1946 showed Ohio to rank 36th among the 48 states in the estimated number of white-tailed deer present.

Mourning dove.—The mourning dove ranks high among the game birds in total kill in the United States. Approximately two and one-half million were reported taken in eleven of the states having open seasons in 1946. Like the bobwhite, however, the dove, as a game bird in Ohio, was given protection from hunting, 1913 to 1947, and, in the latter year, was designated a song bird (Dambach, 1948). In 1949 it was again classified as a game bird but no hunting was permitted.

Ruffed grouse.—In 1947, approximately nine percent of the hunters returning questionnaires reported that they had hunted grouse during the season (Leedy, 1948a). The reversion of land to brush in eastern Ohio is favorable to an increase in grouse populations. The numbers of this game bird that are harvested will

probably remain relatively small because of its wily nature and the difficulties in hunting it. In 1947, for example, 501 grouse hunters bagged only 246 grouse.

Hungarian partridge.—This exotic game bird after having had legal protection from hunters, 1913 to 1917, was hunted in Ohio until 1947 when it was again protected due to its scarcity. In 1946 less than one percent of Ohio's hunters bagged a Hungarian partridge and the total kill in the State was probably less than that for ruffed grouse (Leedy, 1947). Eighty-one out of 8,449 hunters reporting, however, killed 194 partridges.

The Hungarian partridge, relatively abundant in northwestern Ohio in the early 1930's, has decreased sharply in numbers throughout most of its range in the United States. Many states having an open season on partridges in 1936 had closed the season in 1946 and the kill reported by nine states, the latter year, was 61 percent less than that of 1936. In 1946, Idaho reported an estimated partridge kill of 50,000; Ohio, approximately 16,500; and Indiana, 15,000 (Leedy, 1949).

Other game animals.—There are a few black bears in the hilly forested sections of southern Ohio but not enough to warrant an open season on them. Likewise, Ohio has no jack rabbit, snowshoe hare, black-tailed deer, mule deer, antelope, moose, elk, Valley quail, Gambel quail, white-winged dove, sharp-tailed grouse, prairie chicken or wild turkey hunting. While considerable numbers of jack rabbits, showshoe hares and others of these species are killed in the United States the totals are far less than for such species as the cottontail rabbit, the fox and gray squirrels and the ring-necked pheasant which Ohio has in relative abundance.

Insufficient information on the kill of rails, gallinules and woodcocks is available to indicate their status in Ohio as compared with other states. Of these three migratory birds, woodcocks are killed in the largest numbers. Two hundred of 5,599 representative Ohio hunters reporting at the close of the 1947 hunting season had killed 567 woodcocks; 76 hunters had killed 95 gallinules and 71 hunters had killed 54 rails (Leedy, 1948b).

Fur animals.—During the ten-year period 1938 to 1947, Ohio fur dealers reported purchasing an average of more than 900,000 pelts annually (Leedy, 1948b). A comparison of the fur crop harvested during the 1946–1947 season with the ten-year average crop, 1938–1947, is shown in Table II. The estimated annual take of fur animals on a nation-wide basis is indicated in Table III.

The figures on fur production in Ohio do not include the pelts shipped directly to out-of-state fur dealers by Ohio hunters and trappers. It is believed (Leedy, 1948b) that at least 10 percent of the total Ohio fur catch is disposed of in this way. On this basis the average annual take of fur animals in Ohio would be approximately one million pelts placing Ohio among the first half dozen States in fur production. In recent years, 1946–1947, the raw furs taken by Ohio hunters and trappers have had an annual value of approximately $2,000,000.

As evident in Tables II and III, Ohio's common fur bearers are the same species that constitute the bulk of the furs produced in the United States. Louisiana, as shown by Ashbrook (1948), produces far more fur animals than any other State. Among six of the leading fur producing states—Louisiana, Michigan, Minnesota, Ohio, Pennsylvania and Wisconsin—Ohio's ranking in the number of pelts reported taken by species in the 1946–1947 season was as follows: Fox (prifharily red and gray), Pennsylvania first, Ohio fifth; mink, Louisiana first, Ohio fifth; muskrat, Louisiana first, Ohio third; opossum, Louisiana first, Ohio second; skunk, Minnesota first, Ohio fifth; and weasel, Minnesota first, Ohio fifth (Ashbrook, 1948).

Due to their relative scarcity, striped skunks have been given protection from hunting and trapping in Ohio in recent years (1947 and 1948 seasons). Raccoons and foxes, on the other hand, have been more abundant than usual.

Among other fur animals that occur in the State are the beaver, the badger and the nutria (*Myogaster coypus*). Chapman (1949b) estimated that there

were from 100 to 125 beavers in Ohio in 1948, mostly in counties bordering Pennsylvania. There is no open season on the beaver in Ohio at present.

There are relatively few badgers in Ohio. Usually less than ten pelts are purchased annually by Ohio fur dealers, although other individuals are prepared by taxidermists or kept alive by their captors because of their scarcity.

The nutria, an exotic also known as South American swamp beaver or coypu, has been reported in Ohio (Petrides and Leedy, 1948) but is apparently found only as stragglers that have escaped from fur farms.

TABLE II

COMPARISON OF THE 1946–1947 OHIO FUR CROP WITH THE TEN-YEAR AVERAGE, 1938–1947
(After Leedy 1948b)

SPECIES	NUMBER OF PELTS TAKEN[1]		PERCENTAGE COMPOSITION OF FUR CATCH	
	1938–47 Av.	1947	1938–47 Av.	1947
Red fox	9,984	14,592	1.1	1.6
Gray fox	6,362	5,009	.7	.6
Mink	12,384	14,059	1.4	1.5
Muskrat	648,905	698,166	70.8	75.6
Opossum	120,866	73,014	13.2	7.9
Raccoon	45,469	92,615	5.0	10.0
Skunk	61,760	14,914	6.7	1.6
Weasel	10,147	11,442	1.1	1.2
Total	915,877	923,811	100.0	100.0

[1]These figures do not include pelts bought by or shipped directly to out-of-State fur dealers by Ohio hunters and trappers.

TABLE III

ESTIMATED NUMBER OF PELTS PRODUCED ANNUALLY IN THE UNITED STATES[1]

Species	Average Annual Production	Species	Average Annual Production
Muskrat	20,000,000	Ringtail	100,000
Opossum	3,000,000	Bobcat	40,000
Skunk	2,500,000	Badger	25,000
Raccoon	2,000,000	Nutria	20,000
Mink	800,000	Otter	15,000
Fox (red, gray, kit and swift)	700,000	Marten	5,000
Weasel	400,000	Wolf	2,500
Coyote	300,000	Fisher	500
Beaver	125,000	Canada lynx	25
		Wolverine	20

[1]Data supplied by Mr. Frank G. Ashbrook, In Charge, Wild Fur Animal Investigations, Fish and Wildlife Service, U. S. Department of the Interior.

The bobcat, Canada lynx, coyote, fisher, marten, otter, ringtail, wolf and wolverine, either not present in Ohio at all or so rare as not to warrant attention here, are taken in relatively small numbers where they still occur in the United States.

SUMMARY

1. Ohio, ranking 35th in size among the states, and with a population of approximately seven and one-half million people, has a hunting pressure exceeded by no more than three or four states.

2. Although well known for its industrial greatness and its agricultural and mineral production, relatively few people know how it ranks as a game and fur producing state.

3. Wildlife bookkeeping methods, although considerably improved in recent years, are still inadequate. The kill figures presented are to be regarded only as estimates but it is believed they are sufficiently accurate to permit rough comparisons of game and fur production in the various states.

4. Limitations of kill figures as indices of game and fur animal populations are indicated.

5. The cottontail rabbit, fox squirrel, gray squirrel and ring-necked pheasant provide hunting for a high percentage of the country's hunters. In 1947, the percentage of Ohio hunters hunting these species was 81, 48, 31 and 70 respectively.

6. Based upon data furnished by State Game Departments in response to a questionnaire, Ohio ranked first in the combined kill of these four species in 1946.

7. According to compilations made by the Branch of Wildlife Research, Fish and Wildlife Service, Ohio ranks among the six leading states in fur production.

8. Muskrats comprise approximately three-fourths of the state's average fur catch which totals nearly a million pelts and which, during recent years, has been worth about two million dollars annually.

9. The six leading fur animals in the United States, considering the number of pelts produced, are the muskrat, opossum, skunk, raccoon, mink, fox (red and gray) and weasel. These are the fur animals most common in Ohio.

10. Thus, while Ohio has a relatively small kill of waterfowl and big game animals and lacks certain game and fur species altogether, it is one of the leading states in the small game and fur animal harvest.

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